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August 30th 1827.

AN
INTRODUCTION
TO
The Study
OF
FOSSIL ORGANIC REMAINS.

J. Compton, Printer, Middle Street,
Cloth Fair, London.

AN
INTRODUCTION
TO
THE STUDY
OF
FOSSIL ORGANIC REMAINS;

ESPECIALLY OF THOSE FOUND IN
The British Strata:
INTENDED TO AID
THE STUDENT IN HIS ENQUIRIES
RESPECTING
The Nature of Fossils,
AND
THEIR CONNECTION
WITH
THE FORMATION OF THE EARTH.

WITH ILLUSTRATIVE PLATES.

By JAMES PARKINSON,
Fellow of the Royal College of Surgeons, Member of the Geological Society
of London, the Wernerian Society of Edinburgh, and of
the Cæsarean Society of Moscow.

London:
PRINTED FOR THE AUTHOR;
AND SOLD BY
SHERWOOD, NEELY, AND JONES, PATERNOSTER ROW;
and
W. PHILLIPS, GEORGE YARD, LOMBARD STREET.

1822.

PREFACE.

THE following pages are dedicated to the service of those Admirers of Fossils who have not yet entered into a strict examination of the distinctive characters of these interesting substances.

An attempt is made, in this slight but comprehensive sketch, to show the difference of forms and structure in the numerous organised beings with which the earth was peopled before the creation of man; to mark the several circumstances in which they agreed with, or differed from, the inhabitants of the present world; and to point out, from the strata in which they exist, the order in which they probably were formed. The limits of this publication will not always allow a full statement of those minute distinctions which are the objects of research of the more advanced enquirer; but sufficient, it is hoped, will be introduced to enable the student to detect the more decided and more important characters of these substances, and to place them under their appropriate genera.

It may, it is hoped, thus become a useful vademecum for the intelligent traveller who may not yet have attended to these enquiries. At present, disappointment frequently occurs, from the too limited accounts of the fossil remains which offer themselves for examination in different parts of the world: the observer is perhaps satisfied, for instance, with stating that the rocks were found to contain the remains of shells, and that these remains were chiefly of bivalves or of univalves, when, by a little farther investigation of even the fragments of these fossils, aided by reference to a manual of this kind, their genera might have been ascertained, and such marks noted, as, by subsequent comparison with the more correct and elaborate labours of Lamarck, Sowerby, &c., would admit of their species being ascertained, and of important information being yielded on points which, at present, are the subjects of controversy.

The student, already delighted with the contemplation of surrounding creation, will be hereby led into another field of observation, where he will perceive decided traces of the vast changes which this planet has sustained; and will see the remains of those beings with which it was inhabited previous to the creation of man. Circumstances will be observed, apparently contradictory to the Mosaic account, but which, it is presumed, serve to establish it as the revealed history of creation.

The discordance appears to be removed by the assumption of indefinite periods for the six days of creation: an interpretation adopted by many learned and pious men, and which derives confirmation from innumerable circumstances agreeing with the important fact of certain fossils being found to be peculiar to particular strata; and especially from the remains of widely differing races of animals being found in such situations as evince that their creation must have taken place at very distant periods.

For the several imperfections in this work, which may have escaped the author's attention, he craves indulgence; hoping that they will not be found of such importance as to render the wish too presumptuous of having it considered as a humble subsidiary to that scientific and most valuably comprehensive work, "*Outlines of the Geology of England and Wales*," by the Rev. W. D. Conybeare and W. Phillips.

LONDON,
July 1822.

ERRATA.

Page 8, line 5, *for* " combustible" *read* " incombustible."
11, 3, *for* " disposed" *read* " arranged"
57, 36, *for* " pappillosum" *read* " papillosum."
64, five lines from the bottom, *for* " resepores" *read* " retepores."
71, last line, *for* " formation" *read* " formations."
77, line 25, for concluding sentence, *read* " tortuous vallies which held the polypes, and thus separated them."
79, 14, *for* " Explanariæ" *read* " Explanaria."
101, 5, *dele* " &."
147, last line, *insert* " ," *after* " smooth."
170, line 13, *dele* " considerable."
297, six lines from the bottom, *for* " similiarity" *read* " similarity."
302, line 14, *for* " and" *read* " or."
302, 16, *dele* " in."
303, 28, *for* " as" *read* " than."

The reader is requested to observe also, that the *figure* intended to illustrate *Alveolites incrustans*, page 66, and for which a reference is given to *Pl.* II, *fig*. 5, will be found at *Pl.* X, *fig*. 11; and that it having been thought necessary to give an *illustrative figure* of *Tubipora anastomosans*, page 71, it is introduced *Pl.* IX, *fig*. 10.

OUTLINES

OF

ORYCTOLOGY.

ORYCTOLOGY is the science which enquires into the nature, origin, and formation of those bodies which possess the figures, markings, or structure of vegetables or animals, whilst their substance evinces their having been preserved through many ages, by certain changes effected in subaqueous or subterranean situations*.

The substances of which these bodies are formed being generally of a mineral nature, the term *FOSSILS* is applied to them, as declaratory of their having been *dug* from subterranean situations. They have also been termed *adventitious, extraneous,* or *secondary* fossils, to distinguish them from those fossils or original mineral substances which are found in their native state and situations. But as the term fossil, alone, declares these bodies, bearing the obvious and characteristic marks of vegetable or animal organization, to have been obtained from the mineral kingdom, the employment of any of these epithets appears to be unnecessary.

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* The term Oryctology is liable to the objection of not being sufficiently confined, it including, in fact, every substance dug out of the earth; the term Fossil, also, is exposed to the same objection: in excuse for their employment, it must be observed, that this language was formed, and these terms were adopted and had received the stamp of authority from usage, whilst utter ignorance prevailed respecting the nature of the substances to which they were applied. Either, then, the best of these terms must be admitted, a new vocabulary be formed, or perpetual periphrasis be had recourse to: the first has been preferred.

By whatever mode organic remains, in subterranean or subaqueous situations, may be preserved from resolution of their substance for a considerable time, it is obvious that they must be liable to be impregnated with whatever matters may be held in solution in the fluids with which they may be thus imbued. From this source mineral matters may be deposited, by *intromission,* into the original interstices and cavities of the organic body; or may, by *substitution,* fill the spaces which have been produced by the partial removal of the original organic substance; or lastly, may, by *impregnation* and *consolidation* of the chemically altered organic matter itself, produce the several earthy or metallic fossils.

The earthy substances which enter into the composition of fossils, or, as in these cases they may be termed *petrifactions,* are chiefly of the calcareous, siliceous, and argillaceous kinds, in different states, and in various mixtures. The most common of the calcareous genus are the several species and varieties of carbonates; limestone, marble, stinkstone, chalk, spar, oolite, &c. Fluate of lime sometimes occurs as the matrix, and, very rarely, it forms the substance of fossils. Sulphate of lime, though sometimes found crystallized in their cavities, has not been mentioned as forming the substance of fossils. Sulphate of barytes, or baroselenite, is said sometimes to form the substance of fossils, but the instances are very rare. Silex enters, in different combinations, into the composition of fossils: quartz, chert, agate, calcedony, jasper, flint, pitchstone, and semiopal, have all been found forming their substance or constituting the masses in which they have been contained. Alumine frequently also enters into the composition of fossils, as well as of their containing matrices; clay frequently fills their cavities, and forms the beds in which they are found. Bituminous shale, slate, and argillaceous iron stone, often contain fossils. Fullers'-earth has sometimes, though rarely, been found to contain some particular fossils. The nuclei of fossil shells have been formed of hornblende, and both vegetable and animal fossils have been found in substances designated as basalt, wacké, and trap.

The metals which most commonly contribute to the formation of fossils are iron and copper, rarely lead or zinc, and still more rarely silver; they generally exist in the form of carbonates or of sulphurets. The carbonates as well as the sulphurets of iron are chiefly found in vegetable remains. Ligneous fossils of this species present a very curious fact: although the texture of the wood appears to be nearly unaltered, its substance has been so intersected by the crystallizations, that on decomposition it is resolved into an impalpable efflorescence. The specimens of wood which have been mineralized by copper sometimes possess a considerable degree of beauty, from the brilliant colours of the malachite which enters into their composition. The sulphuret of lead, galena, has been found in fossil wood; and blende, the sulphuret of zinc, has been found, with quartz crystals, investing fossil shells. Silver is said to exist in a fossil somewhat resembling the ears of corn, found in the mines of Frankenberg, in Hesse.

Casts or *nuclei* of organic remains are formed by different mineral substances filling their cavities, and thus taking the impressions of their internal forms and markings. *Impressions* of the external surface are formed by investment by the surrounding matrix and by its subsequent induration. After this is accomplished, and the original substance removed, a *cavity* or *mould* is left in the matrix corresponding in its figure and markings with the removed substance. Any mineral matter being introduced into this mould, acquires, as it hardens, a renewal or *redintegration* of the external form of the original substance. This cast is sometimes hollow, having been formed by crystallizations which have only invested the inner surface, but have not been sufficient to fill the cavity.

The casts or nuclei of shells, fruits, reeds, &c. require to be examined to ascertain whether the substance of the fossil is similar or not to that of the matrix in which it is found. If it is similar, the cast may be considered as having been simultaneous in its formation with the bed in which it exists: if not, its substance may have been yielded by percolation and subsequent crystallization in the mould; or it may have been formed in some former bed, on the breaking up of which it may have been deposited among the materials of the succeeding rock in which it is now found.

Vegetable or animal substances deprived of life, and exposed to the action of the air, in combination with moisture, are rapidly decomposed; the softer and more volatile of their constituent principles are dispersed under new forms, and their more solid parts, such as wood and bone, are sometimes left cohering and displaying the form of the original skeleton. When in this state, deprived of those principles which conduce to chemical changes, these substances become capable of continuing unaltered in their forms, in different situations, for comparatively very long periods. But either vegetable or animal substances, when placed, under the influence of moisture, in situations excluding the access of atmospheric air, undergo certain peculiar chemical changes.

Vegetable Fossils.

When vegetable matter is accumulated in so large a quantity that the compactness of the mass may in a great degree exclude the atmospheric air from the internal parts of the mass, a considerable and peculiar change is effected: the vegetable matter soon loses its green and acquires a brownish colour; its flavour and odour are changed, and heat is produced, terminating, unless air is freely admitted, in combustion. The vegetable matter, thus changed into *Hay*, acquires, among its other new properties, that of powerfully resisting any further change upon exposure to the atmosphere.

But should vegetable matter be thus accumulated in a situation in which moisture has almost constant access to it, a very different result ensues. Another process takes place, by which the vegetable matter, as the process goes on, loses its original forms, and becomes a soft magma, of a dark colour and peculiar appearance; no traces of its former mode of existence being discoverable, except in the accidental presence of such vegetable matter as shall not have undergone a complete conversion. When dried, it forms a readily combustible substance, of a reddish brown colour, readily absorbing and tenaciously retaining water, and yielding, whilst burning, a strong bituminous odour. This is the substance termed *peat,* immense accumulations of which are formed in various parts, favourable to the collection of water and the growth of the *sphagnum palustre,* a plant, by the conversion of which the supply of this substance is chiefly supported. In the peat-bogs or mosses, as the natural magazines of this substance are called, trunks of trees are often found imbedded, and partaking of the nature of the surrounding bituminous mass. This change is effected in different degrees: the deeper in the mass, and consequently the longer exposed to the process of bituminization, the more perfect is the conversion. Some pieces are found to have nearly lost their ligneous appearance, their respective lines and markings having been molten down in different degrees during their bituminization; whilst others, in which the nature of the substance is also entirely altered, are found still to retain almost all their characteristic markings. This substance has long been known by the designation of *bituminous wood.*

Wood of a very different character, called *Moss Fir,* is also frequently found in the peat mosses or bogs. It much resembles, in its colour and general external appearance, ordinary decayed fir-wood; but on examination it appears that the fibre of the wood is strongly imbued with resin, and that all its interstices are filled with resinous matter. It is so highly inflammable, as to be employed, by the poor of the districts in which it is found, not only as fuel, but as torches.

As the real nature of this substance is not perhaps known, it would be very desirable that further enquiries might be made respecting it; it might then be determined whether the opinion which is here offered be correct or not. From its retaining the colour and appearance of decayed wood, it is conjectured to be wood which, by exposure to the atmosphere, had sustained the abstraction of all its constituent parts, except the resin and ligneous fibre impregnated therewith; and from its having been thus rendered almost an entirely resinous mass, it has not been affected by the bituminizating process.

Subterranean collections of bituminized wood and other vegetable matter are found at various depths in different parts of the world. The substance thus found is generally a compact, light, glossy, combustible substance; of a dark brown colour, and frequently almost black; splitting longitudinally into plates of various thicknesses, breaking transversely with an imperfect conchoidal fracture, with a shining resinous lustre, and sometimes yielding the appearance of the markings of wood. This is the *suturbrand* of Iceland; the *Bovey coal* of this country, and the *common brown coal* of Thomson.

The fossil wood, now described, may be said to pass into *jet*, which is found, especially in the neighbourhood of Whitby, in Yorkshire, in a state very nearly approximating to that of bovey coal. It exists in plates, generally from half an inch to about an inch in thickness, between which a film of carbonate of lime, with pyrites, is disposed: excepting that it more frequently shows marks of ligneous texture, its characters may be said to be those of jet; its colour, velvet black; internal lustre, shining, resinous; fracture perfect, large, conchoidal; fragments, sharp edged, soft, rather brittle; easily frangible; very light. Jet is found in other situations, in a different form; resembling, in its shape, and the markings of its surface, parts of the branches or trunks of trees, but rarely possessing, internally, any marks of vegetable origin; a circumstance easily accounted for, if its previous softening be admitted.

Cannell Coal, of which some of the finest specimens are found in Lancashire, differs from jet chiefly, perhaps, in its holding a greater portion of earth in intimate mixture with it. It never manifests internally any traces of vegetable structure, but sometimes bears on its surface evident marks of impressions formed on it whilst in a soft state.

Common Coal is composed of a similar bituminous matter, divided by films of calcareous spar mingled with pyrites, intersecting each other nearly at right angles: its fracture is thus rendered small grained, and uneven, and its fragments mostly cubical or trapezoidal. By this division and enclosure of the inflammable bituminous matter in combustible septa, the accension and combustion of this substance are rendered more slow, and better adapted to the purposes for which it is destined. Traces of vegetable structure are very rarely discoverable in coal, except in the impressions of cactuses and of various dorsiferous and succulent plants.

Impartiality here requires that the opinion of Professor Jameson on this subject should be noticed. The Professor, speaking of the coal found in the neighbourhood of Edinburgh, says, " the coal, which is black coal, occurs in beds, seldom more than a few inches in thickness, and is generally contained in the bituminous shale or slate clay, rarely in the sandstone. By the gradually increasing mixture of clayey matter, it passes into bituminous shale. The accompanying bituminous shale and slate clay contain impressions of ferns, a fact which has been adduced in support of the opinion which maintains the vegetable origin of black coal. We are inclined to call in question the supposed vegetable origin of this kind of coal, and are rather disposed to consider it as an original chemical formation; and that the occurrence of vegetable impressions in the adjacent rocks no more proves its vegetable origin, than the existence of fossil quadrupeds in the gypsum of Paris proves that rock to have been formed from the debris of animals of the class mammalia *."

To these opinions it appears to be sufficient to oppose the following deductions of Dr. Macculloch, from his experiments on certain products obtained from the

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* Geognostical Description of the Neighbourhood of Edinburgh.—Edinburgh Journal, vol. i, p. 354.

distillation of wood, &c. The Doctor considers himself as authorised to state, that, "Examining the alteration produced by water on common turf, or submerged wood, we have all the evidence of demonstration that its action is sufficient to convert them into substances capable of yielding bitumen on distillation. That the same action having operated through a longer period has produced the change in the brown coal of Bovey is rendered extremely probable by the geognostic relations of that coal. From this to the harder lignites, surturbrand and jet, the transition is so gradual, that there seems no reason to limit the power of water to produce the effect of bituminization in all these varieties; nor is there aught in this change so dissonant from other chemical actions, as to make us hesitate in adopting this cause." Satisfied that jet, the bituminous lignite which approaches the nearest to coal in its chemical characters, is the result of the action of water on vegetable matter, Dr. Macculloch was induced to try if this substance could, by heat under pressure, be converted into coal: the result of his experiment was, that the produce exhibited the true characters of coal, having not merely the colour and inflammability, but the fracture of coal and its odour on burning *. These experiments and observations, taken with those of Mr. Hatchett, appear to be sufficient to set the question, as to the vegetable origin of coal, at rest.

The vegetable origin of *naphtha, petroleum,* and *asphaltum,* is not yet positively ascertained. *Amber,* from its being found generally in beds of fossil wood; the *blue clay resin* found at Highgate and at Sheppey among the pyritified wood; and the *retinasphaltum* of Mr. Hatchett, discovered among the Bovey coal, may either owe their origin to the changes effected in vegetable matter during its subterraneous deposition, or may be vegetable resins, the original product of the trees which they accompany, and which, from their resinous nature, may have resisted the bituminisating process.

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* Transactions of the Geological Society, vol. I, p. 2.

The argillaceous ironstone nodules which accompany coal, contain, with the remains of many other unknown vegetables, parts of various cryptogamous plants, the recent analogues of a very few of which have been said to be found in some of the tropical regions. On these nodules being broken, the preserved remains are generally discovered on each of the broken sides of the nodule; not, as might be expected, displaying different sides of the vegetable, but the same side of the leaf, for instance, on each broken surface; in one, *in alto*—in the other, *in basso relievo*. The explanation of this curious circumstance, which long puzzled the oryctologists, is found in the vegetable matter, during its passing through the bituminous change, having become softened, and having filled its own mould with its melted and softened substance; the nodule, on being broken, showing on one side the surface of the adherent bituminous cast, and, on the other, the corresponding mould.

In the argillaceous and bituminous slate forming the floors and roofs of coal mines are vast collections of the black bituminized remains of gramina, junci, cryptogami, and of numerous other plants, agreeing in their general characters with those of succulent plants, but differing from the recent ones known in Europe by their vast magnitude, and by the richness of the ornamental markings which appear on their trunks.

Description cannot succeed in an attempt to give an idea of the beauty and varieties of the figures which are displayed on the surface of many of those fossils, and which have been supposed to owe their markings to the bark of different trees of supposed antediluvian existence. Some are ornamented by regularly disposed straight, plain ribs, disposed longitudinally or transversely over their whole surface; some by the decussation of nearly straight lines obliquely disposed; and many, by the alternate contact and receding of gently waving lines, forming areas regularly, but most singularly varying in their forms, and having in their centres tubercles and depressions from which spines, or setæ, have in all probability proceeded. In others, lines obliquely disposed intersect each other at angles, varying in their acuteness in different specimens, in, it would seem, an almost endless variety; forming surfaces apparently covered with squamæ disposed in an imbricated manner, and frequently in quincunx order.

Among the fossils of this description, the one which claims our first attention, is, I. *Phytolithus verrucosus* of Martin; *Petrificata Derbienfia, Pl.* 11, 12, 13, and 13*; Organic Remains, vol. i, *Pl.* III, *fig.* 1; and on a very small scale, *Pl.* I, *fig.* 1 and 2 of the present work. This fossil appears to have foiled every one who has attempted to explain its original nature and mode of existence. It is, according to Mr. Martin's correct account, a subcylindrical, subramose, tuberculated trunk; *Pl.* I, *fig.* 1, with suppressed tubercles in quincunx order, *(a)* having linear lanceolated leaves horizontally disposed, *fig.* 2 *(b)*. In some parts of it is a deep longitudinal sulcus, *fig.* 1 (*c*), beneath which is a rough imbricated body of a slender cylindrical form, *fig.* 2 *(d)*. This, Mr. Martin observes, after a certain distance, appears to strike out laterally, and form a branch; the trunk is then continued for some length, without the furrow or the imbricated body; after which it again appears, and another branch is put out in another direction.

Various opinions have been entertained respecting this interesting fossil, so unlike any of the vegetable substances of the present day, by Da Costa, Woodward, Whitehurst, and others. The author of these pages had conjectured that it belonged to some body resembling the *strobilus* or cone of some vegetable, while the ingenious Mr. Martin describes it as above. The examination of this fossil has been since very assiduously prosecuted by the Rev. Henry Steinhauer (Transact. of the American Philosophical Society, New Series, Vol. I). This gentleman is satisfied that "those bodies which were supposed by Mr. Martin to be leaves proceeding from the trunk, were cylindrical fibres which shot out from the trunk of this vegetable, whilst growing in a horizontal position: he supposes this fossil to have been a cylindrical root or trunk growing in this direction, in the soft mud at the bottom of fresh water lakes or seas, without branches, but sending out fibres from all sides: that it was furnished in the centre with a pith of a structure different from the surrounding wood or cellular substance, more dense and distinct at the older end of the plant, and more similar to the external substance towards the termination which continued to shoot."

These points being assumed, Mr. Steinhauer says, "the manner in which the reliquia were formed is easily explained. Annual decay, or an accumulation of incumbent mud, having deprived the trunk of the vegetative principle, the clay would be condensed by superior pressure around the dead plant, so as to form a species of matrix: if this took place so rapidly, that the mould had obtained a considerable degree of consistency before the texture of the vegetable was destroyed by putrefaction, the reliquium was cylindrical; if, on the contrary, the new formed stratum continued to subside, while the decomposition was going on, it became flattened, and the inferior part might even be raised up towards the yielding substance in the inside, so as to produce the groove, or creesh, as Woodward calls it, on the under side, in the same manner as the floor in coal-works is apt to rise where the measures are soft and the roofs and sides have been secured. While the principal mass of the plant was reduced to a soft state, and gradually carried away or assimilated with mineral in filtrated matter, the central pith being unsupported would sink towards the underside, and this the more sensibly where its texture was most distinct; whilst its anterior extremity would go into putrefaction with, and be lost in the most tender part of the plant. The mineral matter introduced would now form an envelope round the pith, when this resisted decomposition for a sufficient length of time; and when it was ultimately removed, if the surrounding mass was still sufficiently pervious, would be also filled with argillaceous matter, or, if it was too much indurated, be left empty, which is the case occasionally."

But the ingenious author of these observations has omitted to notice the imbricated or reticulated surface of the central substance which has been already noticed, and which, it is presumed, will furnish us with some of the required information; since these configurations doubtlessly depended on the attachment of some parts of the vegetable, and probably were the bases on which were placed those delicately formed tubular processes, which, in the representation of another fossil, from Organic Remains, Vol. I, *Pl.* IX, *fig.* 1, an assumed fossil strobilus or cone (*Pl.* I, *fig.* 3, *a*), are seen to pass from the internal substance to the surface of the vegetable body. From all the information that has been obtained, it appears that this fossil, *Phyt. verrucosus*, was a plant of the succulent tribe, differing from vegetables of the present world, by its containing a more solid part within its succulent substance, from which proceeded a delicate organization by which a communication was preserved with the external surface. It also appears that the species of this genus, distinguished by their characteristic markings, may have been numerous: that the different situations in which the internal part is found in different fossils are attributable to the resolution of the tenderly organized intermediate part connecting the included substance with the surface, and to the other accidents dependent on partial and irregular decomposition, pressure and distortion, occurring during its passage from the vegetable to the mineral kingdom, and very probably in the manner in which it is represented by Mr. Steinhauer.

II. *Sulciculmis* and *Striaticulmis* of Luid, *Pl.* V, 184, 6; Scheuchzer, *Pl.* IV, 1.; *Volkmanni Siles. Subter.* VII, 7; VIII, 6; Martin, 8, 25, 26; Organic Remains, I, *Pl.* III, 3, with a reeded, jointed trunk, is said to resemble the young shoots of the Surinam bamboo.

III. *Phytolithus Cancellatus.* *Volkman. Siles. Subt.* VIII, 10, 11, 12, 13; Martin, 18, 50; Organic Remains, Vol. I, *Pl:* I, 6, II, 4. Mr. Steinhauer has taken considerable pains to detect and explain the different appearances under which the fossil remains of this plant are seen. He has ascertained that there are three distinct kinds of configurations proceeding from it, originating in the epidermis, the bark, and that which may be considered as holding the situation of the wood of the plant. The first, the epidermal, is formed of rhombs, divided by lines forming a network in a manner difficult to express, by drawing or description, which leaves the rhombs still approximate. The impression of this part is represented *Pl.* I, *fig.* 4.

In the second, the cortical, the lines between the rhombs are of more breadth, the ridge is broader and less defined, and forms with the contracted superior elevation a protuberance, and the central part assumes the figure of a squamula. *Pl.* I, *fig.* 5, represents the matrix or cast of this part. The third, the ligneous, configuration differs extremely from the two former, and only close observation determines that it originates from the same plant. The cancellated appearance is here entirely lost; the surface is slightly striated with a scarcely perceptible rising under the central ridge, and a minute but distinct raised dot in the place of the depression in the epidermis. It has all the appearance of a peeled plant, which had been furnished with small branches or spines in quincuncial order (*Pl.* I, *fig.* 6). From the various modifications of these forms, the different aspects of this protean fossil, Mr. Steinhauer thinks, may be explained.

IV. *Phytolithus parmatus.* This fossil is figured by Scheuchzer, *Herbar. Diluv.* p. 119: it is distinguishable by a singular organization observable on its surface; a series of circular or oval scutellæ, or shields, are placed close to each other in a right line across the surface. There are three distinct appearances; two of these, the epidermal and ligneous, somewhat resemble each other, but the latter is seldom met with. "In the epidermal," Mr. Steinhauer observes, "the parmæ are surrounded by a raised margin, the included disk swells towards the central umbo or boss in curiously disposed rugæ; and the boss is generally more or less excavated in the centre. These configurations on the surface of the shields vary in almost every specimen; yet so that it is not difficult to trace their analogy and the identity of their different marks. The raised margin is constant, and there is always a tendency of the other lines and protuberances towards the centre; not in the direction of the radii, but in a manner slightly resembling the figures on the back of an engine-turned watch, produced by describing several circles whose centres are situate in the circumference of another circle round the middle of the plate.

V. *Phytolithus imbricatus*, Organic Remains, *Pl.* I, *fig*. 6. This is the fossil figured by Mr. Martin, *Pl.* III, *fig*. 4, and to which Mr. Steinhauer has given the name of *Phytolithus Martini*. The trunk is round and tapering, sometimes branched, leafy, covered with scales. Leaves crowded, seemingly one from each scale; subulate, marked with a strong rib: scales rhomboidal, sharp pointed, slightly carinated or keeled, close, imbricate, covering each other in such a manner that the whole surface of the stem appears regularly divided into rhombs.

VI. *Phytolithus transversus* of Steinhauer appears to be the fossil already referred to, page 13, and figured (*Pl.* I, *fig*. 3, *a*), in illustration of *Phytolithus verrucosus*.

VII. *Phytolithus notatus* and *Dawsoni* of Steinhauer appears to belong to the same vegetable. Perhaps the former, *Phyt. notatus*, bearing longitudinal series of cicatrices of a rounded pentagonal form, with a central marking, and the series separated by very distinct sulci, bears the marks of the epidermal character, whilst the latter shews the marking of the ligneous part.

VIII. *Phytolithus tesselatus*. Surface tesselated with rhomboidal plates, formed by the transverse separations of longitudinal costæ; or of longitudinal sulci, if in the impressions of the matrix.

Although much is still left for investigation respecting these fossils, there is very little doubt that the ingenious observations of Mr. Steinhauer may lead the industrious enquirer to making still more definite and important distinctions. These observations are interesting, not only as yielding collateral evidence of the vegetable origin of coal, but as leading to a probable conjecture of the particular plants which have been the chief source, from which the vast stores of that beneficent provision for man has been derived. These remains, in common with all others found in slate, are almost always in a flattened state, from which some deception has arisen with respect to their original forms. But the examination of the vegetable fossils contained in the accompanying beds of limestone and sandstone, where compression has not taken place, yields the important information that these vast substances which have been here found imbedded, and which have been hitherto considered as fossil trees, are the remains of similar vegetables with those found in the beds of slate, but here existing in their original forms, and agreeing in their size with those succulent plants which are now known to be growing within the tropics.

Many accounts have been given of the trunks of trees, whose cortical markings were entirely unknown, having been found in the sandstones of Staffordshire, Derbyshire, Lancashire, and, indeed, in all those parts in which the coal formations have been explored. Having been favoured with the opportunity of examining several specimens of this nature, through the kindness of Thomas Botfield, Esq. of Bewdley in Worcestershire, I am enabled to say, that these are not generally the remains of trees, but of succulent plants, the firm cortical parts of which having been converted by the bituminizating process into jet, have formed that firm tube which is often found, in these instances, filled with sandstone, agreeing with that of the general matrix, and possessing the space left by the waste of the internal succulent part of the plant. The description of the last announced fossil of this kind, found in the neighbourhood of Glasgow, agrees exactly with the general account of these supposed fossil trees, and will, it is presumed, corroborate the opinion which has been just advanced.

In a quarry of sandstone belonging to the coal formation on which Glasgow is built, and in the neighbourhood of that city, it is stated, that " the quarrymen came upon the cast of a tree *in situ* just as it had been growing. The trunk is about twenty-six inches in diameter, not quite round but somewhat oval, so that the north and south diameter is several inches longer than the east and west diameter. The body of the tree itself is composed of sandstone precisely similar to the rest of the quarry; but the bark has been converted into perfect cherry coal, which adheres firmly to the tree, and renders it easy to remove the rock with which it is incrusted. About three feet of the bottom part of the tree has been uncovered; this portion is situated about forty feet below the surface of the earth in a solid quarry of sandstone. The upper part of the trunk and branches has not been discovered: indeed, it is some time since the upper portion of the quarry was removed. The roots may be seen dipping down into the earth precisely as the roots of living trees do. Four very large roots may be seen issuing from the trunks, and extending, some of them, about a foot before they are lost in the surrounding stone. There is nothing to indicate the species of tree of which the mould has been here preserved. From the appearance of the roots it is obvious that it was not a fir; it had more resemblance to a beech: the bark has been so completely bituminized, that its usual characters are effaced. The petrifaction, however, is not without its value; it demonstrates that the sandstone has been formed at a period posterior to the existence of large trees, and that the water-worn appearance of the quartz pebbles of which the sandstone is composed is not a deceitful indication." Hence the ingenious observer is led to observe, that "if the sandstone, which constitutes so great a proportion of the coal beds, be a formation posterior to the earth being covered with wood, we can entertain no doubt that this is the case also with the slate clay and the coal which alternate with this sandstone. Indeed, if the coal formation exists as a portion of the old red sandstone, we can entertain no reasonable doubt that the old red sandstone itself has been formed after the earth was covered with wood."—*Annals of Philosophy*, Nov. 1820.

The size which these fossil plants have attained, compared with that of the cactuses known in Europe, must, as in the fossil last mentioned, lead to a doubt as to this opinion of their agreement with the recent cactus. But to be enabled to form a correct judgment on this point, it is necessary to know the state in which these plants exist where the soil and climate are such as to allow them to develope themselves in their native luxuriance. The researches of the celebrated Humboldt, in the equinoctial regions, supply us on this head with the most appropriate and satisfactory information. The following detached observations of that philosopher will show not only the size to which these plants may arrive, but the vast tracts which, under favourable circumstances, they may overrun, as well as the great probability of their having been the first vegetable clothing of the earth. "The hill of calcareous breccia, which we have just regarded as an island in the ancient gulph, is covered with a thick forest of columnar cactus and opuntia, some thirty or forty feet high, covered with lichens, and divided into several branches in the form of candelabras, wearing a singular appearance. Near Maniquarez, at Punta Araya, we measured a cactus, the trunk of which was four feet nine inches in circumference. The European, acquainted only with the opuntia in our hot-houses, is surprised to see the wood of this plant become so hard from age, that it resists for centuries both air and water, and that the Indians of Cumana employ it in preference for hords and doorposts. Cumana, Coro, the island of Margaretta, and Curacao, are the places in South America that abound most in the plants of the family of the nopals. There, only, a botanist can compose a monography of the genus cactus, the species of which vary not only in their flowers and fruits, but in the form of their articulated stem, the number of costæ, and the disposition of the thorns: the divisions of property are marked by hedges formed of the agave and cactus. At San Fernando, S. A., the soil abounds in aquatic plants with sagittate leaves, and he remarks that some of these succulent plants are from eight to ten feet high. In Europe their assemblage would be considered a little wood." He also mentions a kind of bamboo which the Indians call jagua, which is found near San Fernando, more than forty feet in height. These, he observes, cannot but remind the admirer of fossils of the vast fossil bamboos which are found in the sandstones accompanying coal. Speaking of a rock of considerable height and magnitude, he observes, " Euphorbium, cacalia, kleinia, and cactus, which are become wild in the Canary Islands, as well as in the south of Europe and the whole continent of Africa, are the only plants we see on this arid rock, being plants which draw their nourishment rather from the air than from the soil in which they grow." He also remarks, " It is not, in general, by mosses and lichens that vegetation in the countries near the tropics begins. In the Canary Islands, as well as in Guinea and in the rocky coasts of Peru, the first vegetables that prepare the mould for others are the succulent plants."

These interesting observations, taken into consideration with the appearances yielded by the fossils accompanying coal, lead to the further consideration of the formation of that substance. From its chemical characters, its bearing the impressions of vegetables, and being surrounded with vegetable remains in the roofs and floors of the mines and the accompanying coal-measures, its vegetable origin, it is presumed, may be fairly inferred. The examination of the various fossil vegetables which accompany it has determined that they chiefly belong to the grasses, reeds, the cryptogamous and the succulent plants, and point out the kind of vegetables which most abounded, and, perhaps, to the exclusion of trees and aborescent plants, at that period when the land first escaped from the dominions of the waters. It is true, that an exact agreement between the forms and markings of these fossil remains, and of those of the succulent plants which are offered to our observation in the present day, is not observable; but it should be considered that analogy will not authorise the expectation of an exact agreement, since it is very rarely to be found between the fossil remains and the animals now existing, owing to the extinction of whole tribes from which those fossil remains have proceeded. Besides, considerable differences must result from the greater size observable in the fossil vegetables, especially in those of the succulent tribe, and which may be corroborated by observing how much the succulent plants of Italy differ in size and form from those of South America and of other regions in the warmer climates.

Proceeding now to the examination of vegetable fossils, in which the introduction of earthy or metallic particles has taken place, it may be necessary again to observe, that wood or other vegetable matter is not likely to undergo this kind of impregnation whilst in a state of soundness and integrity, but that the states most favourable for this kind of change are that kind of *decay* which has been produced by the abstraction of almost all the constituents except the ligneous fibre, leaving that substance to which is generally applied the term rotten wood, and that *spongeous state* which accompanies bituminization. The admission of water in this latter state, strongly impregnated with earths or metals, must, as the deposition and consequent earthy or metallic change proceeds, stay the further progress of the bituminizating process, and, giving solidity to the mass, secure the conservation of the form and even structure which the mass possessed at the period when this impregnation commenced: and here it may be observed, that specimens of silicified wood exist, in which it may be seen that petrifaction has arrested the bituminizating process in wood in almost all its stages.

I. CALCAREOUS VEGETABLE FOSSILS.—Lime is not very frequently the mineralizing matter of vegetable fossils; it is however sometimes found introduced into the remains of wood in the form of spar, and sometimes it becomes, in the form of limestone, the internal substance of fossil reeds and of various succulent plants.

1. *Calcareous spathose wood previously decayed.*—Colour light brown, surface rough and dull, but susceptible of polish; fracture dull, uneven, and rather spicular; interstices filled with nearly colourless spar. The lime being removed from this fossil by muriatic acid, a considerable portion of light-coloured flocculent substance is deposited Found in alluvia and in the ooïite formation.

2. *Calcareous spathose wood previously bituminized.*—Colour darkish red brown; surface commonly rough, but partially glossy; fracture dull, uneven, and

rather spicular, veined with spar of a lightish brown colour. Found in the clay of bituminous slate accompanying the lyas.

The lime being removed by the muriatic acid, a considerable volume of dark brown powder remains, which, when dried, is remarkably combustible, burning with a flame resembling that of some of the pyrophori. On the brown spar being subjected to the action of diluted muriatic acid, the bituminous matter with which it is coloured rises in a film to the surface of the solution.

The polished surface of both these fossils being examined with a lens, the spathose substance is seen to have permeated the minutest woody fibres in all their directions. The powder deposited during the solution of both these fossils is undoubtedly the woody fibre reduced to this state of minute division, in consequence of its penetration in every direction by the spathose crystallization.

II. Siliceous Vegetable Fossils.—The mineralization of vegetable substances is most frequently effected by those impregnations in which silex is the principal constituent; the fossils thus formed being remarkable for the correctness with which their forms and markings have been preserved.

1. *Siliceous wood.* Its colour is generally greyish and yellowish white, thence passing into ash grey, greyish black, and different shades of brown. Its internal lustre is glistening, its fracture more or less perfect conchoidal, showing the ligneous texture. The fragments sharp-edged and translucent. It is harder than opal, and easily frangible.

It is found in many parts of the world, but some of the finest specimens are obtained in the neighbourhood of Schemnitz and at Telkabanya in Hungary.

It is frequently found in this island in the diluvian detritus, and in almost the whole of the green sand formation. Very large fragments are found in the Portland stones, the interstices of which are often beautifully sprinkled with quartz crystals. Interesting specimens are also discovered in the gritstone of the same formation in the Blackdown-pits of Devonshire, which are frequently rendered very interesting by the delicate amianthine form in which the silex is disposed. Specimens are also found in the sands of Bedfordshire. It is but rarely found in chalk; it however forms the nucleus of a flint nodule which is said to have been obtained in Berkshire.

Besides the general characters of siliceous wood, the *peculiar resinous glistening lustre* which it often possesses demands particular notice. It exists in so many degrees, and under such distinct modifications, as to divide it into several species. This peculiar lustre, so nearly resembling that of wax or rather of resin, giving such an appearance as might be expected from a mixture of fluid silex and bitumen, and existing in specimens in which strong and indisputable markings of the woody fibre were to be seen, gave rise to the opinion offered in a former work, that these specimens were the result of the siliceous impregnation of wood in different degrees of bituminization; the gently contorted and softened lines of the ligneous texture presenting the appearance of their having been in a softened state previous to their petrifaction.

With the hope of determining whether bituminous or even carbonaceous matter existed in these specimens or not, several experiments have been employed; but when the fugacious nature of bitumen and the refractory nature of silex, yielding only to the most destructive processes, are considered, the difficulty of the necessary separation and analysis must be obvious, and the following results must at least be admitted to show the propriety of still further extending the enquiry.

By the exposure of *opaline wood* in a retort to the heat of a furnace, the presence of carbon was determined; a strong empyreumatic smell, and an oily sublimated matter possessing the same odour, was produced: the same results have proceeded from a similar treatment of *pitchstone,* bearing a ligneous appearance. Mr. Klaproth, on igniting the brown red semiopal of Telkebanya in an open crucible, found that the iron contained in the fossil was reduced to a reguline state, although there had been no admixture of any charcoal, or of any other substance with a nearer affinity with oxygen, showing that the carbonaceous principle existed in the fossil itself. The same celebrated chemist analyzing the hydrophanous opal of Saxony, obtained, as Mr. Pepys had done from opaline wood, a water having an empyreumatic smell, and covered with a thin greasy pellicle: he also determined afterwards the actual presence of bitumen in the semiopal of Mahren.

Specimens exist which show the union of silex with bituminous wood in all its different stages of bituminization. In one specimen of black siliceous wood, pieces of coal exist in its internal part: in one silicified specimen with evident characters of previous bituminization, patches are seen on its surface of a jet black, and possessing the resinous lustre: in another are spread drusy crystals of quartz, of a dark black, from the union of black bitumen with silex; whilst the black bitumen may also be seen thus intimately combined with silex in the quartz crystals, and imbedded, unaltered, in the interstices of the same specimen. But whether it be admitted or not that the resinous lustre proves the previous bituminization of the fossil wood, the different degrees, and the presence or absence of this character, may be had recourse to in marking its different varieties, and their approximation to other mineral substances.

The varieties of siliceous wood depend not only on the nature of the combinations forming the lapideous matter of which it is chiefly constituted, but also, as has been already observed, on the state of the wood previous to its petrifaction. When the fossil is light coloured and of a shivery texture, the wood may be presumed to have been previously in a decayed state, or, as it is termed, rotten wood; and when close, compact, and dark coloured, it may have suffered previous bituminization.

A. *Chalcedonic wood.*—In the most common form in which this variety appears, the colour is of a yellowish white, the substance resembling that of withered wood. The surface rough and splintery, the splinters frequently so minute as to be wafted with the slightest breath. The internal part solid, chiefly formed of the translucent siliceous matter, which fills the interstices and such cavities as may have been formed by the teredines and other insects, and also sometimes invests the ends of the specimen in a mammillated or stalagmitic form. Specimens occur in which previous bituminization also appears to have taken place, and in which the clear siliceous substance appears as if it had transuded into the cavities, and had exuded at the ends of the specimens.

Here must be referred those amorphous specimens which possess a rough surface, scarcely any lustre, with patches of apple green colour and of a quartzose hardness, intermixed with others of a light or light grey colour, considerably softer. When cut and polished, the white parts display evident marks of vegetable texture; either that of very fine-grained woods, or of some of the palms or reeds, the spaces between being filled with siliceous matter, either translucent, or of an apple green colour.

B. *Jasperine wood* displays all the colours and appearances belonging to common jasper, so disposed as to mark the existence of ligneous texture, and frequently so varied as to give the resemblance of different woods. It is usually opaque, but sometimes translucent at the edges, and sometimes in patches, where it appears as jasper-agate. Its fracture passes from conchoidal to flat and earthy: its internal lustre is generally dull, but sometimes approaching to resinous; its interstices are frequently set with minute crystals. The texture of the wood is discoverable in some very rare specimens of *Heliotrope*, or bloodstone.

C. *Opaline wood* occurs in pieces of a yellowish or yellowish-white colour, passing into different shades of brown: surface generally marked by the ligneous structure, and possessing a resinous lustre. The fracture more or less approaching to perfect conchoidal, showing the ligneous marking and a glistening lustre. Fragments sharp-edged, and somewhat translucent: the surface sometimes dull, like wood, and the internal substance transparent.

It is considered by Dr. Thompson as consisting of wood penetrated by opal, and as being so intimately connected with opal, that it would perhaps be better to unite them.

D. *Pitchstone wood.*—Specimens of fossil wood, evidently showing its original texture, and answering to the characters of pitchstone, are frequently seen: its colours are yellow, brown, reddish brown, red, black, white, and grey, with various intermediate shades; fracture is flattish, imperfectly large conchoidal; lustre varying between dull, vitreous and resinous.

The woody texture is to be traced also in numerous lapideous substances bearing the intermingled characters of pitchstone, opal, jasper, chalcedony, jasper-agate, &c.

III. ALUMINOUS VEGETABLE FOSSILS.

1. *Bituminous slate, schistus, and shale, containing vegetable remains*, are frequently met with in the neighbourhood of coal. These remains, as have been already mentioned, are of various gramina, cryptogami and succulent plants. On allowing some of these bodies to remain in water, their substance becomes softened down, and is resolved into a mass in which the vegetable matter is obvious.

2. *Aluminous wood.*—The wood which has been thus named by different authors, by its proneness to combustion, and by the other properties which they describe it to possess, should be considered as pyritous wood, having obtained its change in the ferruginous clay in which it has been imbedded.

The mineralizing matter of metallic fossil vegetables is most commonly the pyrites or sulphurets and carbonates of iron, copper, zinc, or lead.

I. FERRUGINOUS FOSSIL WOOD.

1. *Pyritical.*—In this fossil the sulphuret of iron pervades the charcoal into which the vegetable matter has been converted. When first found it generally possesses metallic brilliancy, is sufficiently hard to scratch glass; emits sparks on collision with steel, and displays the forms and markings pointing out its vegetable origin; but it soon begins to suffer from decomposition, when its characters change, and it finally resolves into a saline flocculent substance.

2. *Carbonated.*—In these specimens, which are of different shades of brown colour, and generally of an uniform substance, the marks of the vegetable origin are easily observable, although not so distinct as in the

specimens of the preceding species before the commencement of decomposition.

II. FERRUGINOUS FOSSIL SEEDS, &c.

Innumerable seeds, seed-vessels, &c. have been found, by Mr. Crow and others, in the blue clay of Shepey, in the state of pyrites. Most of these belong to plants unknown to our botanists; the existing plants, to which the others seem to approximate, are some of those of the warmer climates.

III. CUPREOUS FOSSIL WOOD.

1. *Pyritical.*—This fossil is distinguishable from the ferruginous pyritical wood, by the pyrites being of rather a darker colour, but chiefly by the blue or green colour which partially pervades the fossil.

In some specimens, in which the general appearance is that of bituminous wood, the metallic impregnation can only be detected by the weight of the fossil and the blue or green hue on its surface.

2. *Wood converted into carbonate and hydrate of copper.*—Cupreous wood in this state forms very beautiful specimens, displaying, not only on its surface, but in its substance, mingled with the charred wood, the most vivid blue and green colours, with patches of the carbonate in the state of malachite.

The finest specimens of cupreous wood are obtained from the copper mines of Siberia.

3. *Wood mineralized by lead.*—Specimens of wood containing *galena*, the sulphuret of lead, have been chiefly discovered in Derbyshire.

The *leaves of plants*, except those of gramina, junci, and of the cryptogamia, are seldom found in a mineralized state. The lobes and pinnulæ of ferns, as has been before mentioned, are frequently found in a bituminized state in nodules of ironstone, and in immense quantities with the remains of gramina and succulent plants in the schistose and slaty coverings of coal.

Among the numerous remains of plants very few are found which agree in their specific characters with any known species, and many indeed differ so much as to render it difficult to determine even the genus under which they should be placed.

The leaves of trees are only found in substances which appear to be of modern formation. Among these are said to have been found those of the willow, the pear-tree, mulberry-tree, and of several others. These have been found in fossil calcareous stone, chiefly in that of Oeningen, and in the calcareous tufa bordering those lakes and rivers which abound in calcareous matter. Leaves are sometimes found in sandstone which somewhat resemble those of trees, but which most probably have belonged to aquatic plants.

In the grey chalk, small white ramose forms are found, which pervade the chalk, and have the appearance of being of vegetable origin. My attention was first drawn to these remains by Mr. Mantell, of Lewes, who, it is to be hoped, may be able to present some further information respecting them in his forthcoming work on the Fossils of the South Downs.

Wood, and other vegetable substances, are frequently found in clay and limestone in the state of charcoal. It cannot always be ascertained by what means this change has been effected; but in that which is found in the blue clay, and in other situations in which pyrites prevail, the change may safely be attributed to the decomposition of the pyrites with which those substances had been impregnated.

Mosses, Confervæ, &c. — Rounded pebbles, called moss agates, are frequently found on the coast of the North Riding of Yorkshire: and Dr. Macculloch describes them as having been found on the shore at Dunglas, in Scotland, containing substances which have the appearance of vegetables.

Daubenton and Blumenbach had expressed their conviction of the vegetable origin of these substances; still many considered them as entirely mineral: but Dr. Macculloch, pursuing this enquiry with his usual zeal and acuteness, observes, that deception is very likely to arise in these specimens, from the well known metallic arborizations emulating the vegetable forms, becoming blended with the real vegetable; and from the actual investment of the whole plant with carbonate of iron; but the most common source of deception and obscurity, in the Doctor's opinion, "will be found in the whimsical and fibrous disposition occasionally assumed by chlorite, its colour often imitating the natural hue of a plant as perfectly as its fibrous and ramified appearance does the disposition and form of one." All the plants that have been discovered in this state of envelopement in quartz appear to belong to certain species of the cryptogamia class, chiefly byssi, confervæ, jungermanniæ, and the mosses. The stones found at Dunglas, Dr. Macculloch observes, "contain remains of organized substances of an epocha at least equally antient with that in which the vegetable remains found in the *floetz* strata existed. As the species ascertained by Daubenton have, in all probability, been preserved in recent formations of chalcedony," so the Doctor thinks that "those which he describes have been preserved in the chalcedonies of former days *."

The moss agates of the Yorkshire coast appear to be of the ancient, whilst other specimens which I possess prove the correctness of Dr. Macculloch's opinion, that some of these fossils are of recent formation.

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* Geological Transactions, vol. ii, p. 511, 518.

The remarks of Dr. Macculloch on the mode in which these curious investments were accomplished, deserve particular attention. "The remains are, in fact, (if I may use such an expression) embalmed alive. To produce this effect, we can only conceive a solution of silex in water, so dense as to support the weight of the substance involved, a solution capable of solidifying in a short space of time, or capable at least of suddenly gelatinizing previously to the ultimate change by which it became solidified into stone *."

Dr. Macculloch describes and figures a congeries of tubuli contained in an oriental agate: similar substances are found in the pebbles on the Yorkshire coast; and in one which I possess the tubules are disposed in a confused radiated form, giving more of the idea of a zoophyte than of a vegetable substance.

A knowledge of the vegetable fossils peculiar to the different strata will, in all probability, open to us considerable stores of instruction; we may thereby learn, not only the nature of the several vegetable beings of the earlier ages of this planet, but may ascertain the order in which the several tribes were created: and, reckoning upon the considerable advance which has been made in our knowledge of the structure of the earth, and upon the eagerness with which enquiries respecting the organic remains of former periods are pursued, the attainment of such knowledge, it may be presumed, is not far distant.

At present we know of no vegetable remains of earlier existence than those which belong to the coal formation; and these appear to be chiefly derived from various grasses and reeds, and plants of the cryptoga-

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* Geological Transactions, vol. ii, p. 522.

mous and succulent tribes, many of which are not known to exist on the surface of the earth at present. From the latter of these the coal itself appears to have chiefly proceeded. In the mountain limestone above the coal, and in the different members of this formation existing between this and the blue lyas, vegetable remains appear to be of but rare occurrence; so that particulars of such as have been discovered in these situations may furnish much useful information, and especially with respect to those fossils which are supposed to have derived their origin from wood.

It has been assumed that wood, or parts of trees, have been found in coal and in the accompanying coal-measures, but some confirmation of these accounts seems to be required. The description of these fossils has seldom been so particular and exact as to yield positive evidence of their original nature; and, as has been already shown, the instances are by no means infrequent in which the traces, and even the remains of cactuses and other succulent plants, had given rise to the belief of the existence of fossil trees in these strata. This opinion may therefore have obtained seeming confirmation from the ligneous hardness which large plants of this kind might have acquired, and which, perhaps, might be traced in their mineralized remains.

The earliest stratification in which fossil wood exists is not perhaps at present determined; but it seems that the earliest appearance in this island of fossil wood, which by its uniformity of character appears to belong to a particular bed, is the spathose bituminous wood of the blue lyas, as found at Lyme in Dorsetshire, and in the neighbourhood of Bath (p. 22). In the next formation, and particularly in that of the green sand, siliceous fossil wood occurs frequently. Very delicate specimens are found in the sandstone, the *whet-stone* of the Blackdown hills of Devonshire. The specimens of fossil wood found in the Portland stone are frequently of very considerable size, and bear all the characteristic marks of wood: these are also siliceous, and are often beautifully sprinkled on their interior surfaces with quartz crystals. Siliceous fossil wood is also found in other situations, as in the sands of Wooburn in Bedfordshire: it also occurs at Folkstone in Kent, in that part of the green sand where it approximates to the superincumbent marl, in which it is also found. Traces of wood are hardly ever discovered in the chalk itself, and so rarely in the accompanying flint nodules, that the knowledge of but one specimen, an instance of this occurrence, is known to the writer of these pages. But in the blue clay, incumbent upon this immense accumulation of chalk, fossil wood, pierced with teredines, and impregnated with calcareous spar, is exceedingly abundant: and in almost every sunken part of this bed, and even of the whole surface of this island, the remains are discoverable of vast forests which have suffered little other change than that of having undergone different degrees of bituminization.

By these facts we learn that, at some very remote and early period of the existence of this planet, it must have abounded with plants of the succulent kind, and, as it appears from their remains, in great variety of forms and luxuriancy of size. These, from what is discoverable of their structure, beset with *setæ* and spines, were not formed for the food of animals; nor, from the nature of the substances of which they were composed, were they fitted to be applied to the various purposes to which wood, the product of the earth at a subsequent period, has been found to be so excellently adapted, by man. Their remains, it must also be remarked, are now found in conjunction with that substance which nature has, in all probability, formed from them; and which, by the peculiar economical modification of its combustibility, is rendered an invaluable article of fuel. If this be admitted to be the origin of coal, a satisfactory cause will appear for the vast abundance of vegetable matter with which the earth must have been stored in its early ages: this vast, and in any other view useless, creation, will thus be ascertained to have been a beneficent arrangement by Providence for man, the being of a creation of a later period.

Animal Fossils.

The mineralized remains of animals are found in subterranean situations, in almost every part of the globe which has been explored. The immense number, the high antiquity, and the general disagreement of these remains with those animals which now exist, give rise to the most interesting and important conjectures. Correct investigation is therefore demanded: a careful comparison of the respective characters of these substances must be made, and the various circumstances belonging to their present extraneous situations be endeavoured to be ascertained.

Zoophytes.—These substances, possessing an animal nature under forms approaching to those of vegetables, frequently occur in a mineralised state. The inquiries respecting them will, for obvious reasons, be first directed to those which are of the simplest forms and structure.

Sponge is, in its recent state, a polymorphous, soft, porous, flexible and elastic body, manifesting a small portion of irritability and vitality. It is composed of fibres of a peculiar substance disposed rather in a membranaceous form, blended with minute spiculæ of various figures; the whole connected in a variously formed network, and invested by a light gelatinous matter.

Count Marsilli, who had the most favourable opportunities of examining into the nature of this substance, was satisfied, although led to the belief of its being a vegetable, that he had many times observed a regular systole and diastole taking place in some of its more circular apertures. But neither M. Peron nor M. Bosc have been able to confirm these observations*.

With the hope of facilitating the distinction and arrangement of those sponges which may be discovered in a mineralised state, it has been thought advisable to give the following table of the divisions of sponges which have been adopted, and of the species which have been noticed by M. Lamouroux†; adding those specific characters which appear to be most distinctive and most likely to be discoverable in the fossil specimens.

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* The following remarks on the nature of this substance merit attention:—Although the animal nature of sponge is generally admitted, no circumstance which may serve to illustrate its history, and tend to dispose of it in its proper place in the system of nature, should be unnoticed. The following observations of Dr. Fyfe may indeed be considered as adducing very important evidence on this subject. Sir Humphrey Davy had procured iodine from several of the fuci and ulvæ, but not from the alkaline matter manufactured at Sicily, Spain, and the Roman states, nor did he find that the ashes of coral or of sponge appeared to contain it. From various experiments Dr. Fyfe was enabled to conclude that iodine was confined not only to the class cryptogamia, but to the marine productions of this class. Sponge being however considered to belong to the animal world, forms an apparent objection to this conclusion. But it must be remembered that Linnæus was inclined to regard sponge as a vegetable substance, and to place it in the class cryptogamia, subdivision algæ aquaticæ; but was doubtful of the correctness of this arrangement. "May not the fact," Dr. Fyfe observes, "that sponge contains iodine, be an argument in favour of the opinion of Linnæus, that this substance properly belongs to the vegetable world, class cryptogamia, from the plants of which iodine is obtained?"—*Account of some Experiments, made with the view of ascertaining the different Substances from which Iodine can be procured.* By Andrew Fyfe, M. D. *The Edinburgh Philosophical Journal, vol. i, p.* 254.

† Histoire des Polypiers Coralligenes flexibles, &c. par J. V. F. Lamouroux, D.E.S. *Caen*, 1816.

I. Sessile masses, simple or lobated, either covering or enveloping.

Species.

1. *S. communis*. . . .—Large flattish masses, rather convex; pores large; crevices and grooves chiefly beneath.

2. — *lacinulosa*. . .—Surface finely porous, downy and jagged; edges ciliated.

3. — *sinuosa*. . . . —Tissue fibrous and stiff; holes and crevices numerous and deep.

4. — *cavernosa*. . .—Stiff and hard, very cavernous; mammillated, and irregularly porous.

5. — *cariosa*. . . . —Rudely shaped; irregularly lobed; cavernous, and jagged as if eroded.

6. — *licheniformis*.—Rather glomerated, and a little branchy; fibres very lax.

7. — *barba*. . . . . .—Fibre shaggy and rather straight, resembling the beard of a goat.

8. — *fasciculatus*. .—Fibres in fasciculi, terminating in pencils at the surface.

9. — *lacera*. . . . . —Terminating in jagged, branchy lobes.

10. — *filamentosa*.—Formed of numerous bundles of distinct filaments.

11. — *favosa*. . . . —Surface membranaceous; nearly covered with subangular, irregular cells.

12. — *cellulosa*. . —Beset with subangular cells; interstial membranes full of pores.

13. — *septosa*. . . .—With nearly erect lamellæ, decussating and forming irregular cells.

14. — *fenestrata*. —With reticulated fibres, in unequal and winding divisions.

15. — *crassiloba*. . —Encrusting; deeply lobed, with thick, erect, flattish, conoidal lobes.

16. — *tabula*. . . . —Flat, oblong, nearly undivided; full of pores.

Species.

17. *S. placenta*. . .—Obliquely circular, plano-convex; rigid, full of pores, radiated in grooves at the edges.

18. — *byssoides*. . .—Flat; formed of distinct fibres, and loosely cancellated.

19. — *pulvinata*. .—Smooth, like a cushion; rarely lobed.

20. — *carbonaria*.—Black and mishapen.

21. — *incrustans*.—Investing, with a thin crust.

22. — *agaracina*.—Compressed, lobed, reticulated, and externally covered with a downy substance.

23. — *cristata*. . .—Flat, with erect and delicate ridges growing in the shape of cocks' combs.

24. — *domuncula*.—Convex, smooth, slightly papillary, and very cellular.

25. — *globosa*. . . .—Rounded, firm, and very cavernous; the surface sprinkled with smooth papillæ.

26. — *macida*. . . —With white, crustaceous fibres, terminating in points.

27. — *panicea*. . .—Resembling, in its form, crum of bread; and composed of bundles of fine needle-like fibres, crossing each other.

28. — *papillaris*.—Crustaceous, tender, soft, and with perforated papillæ.

29. — *urens*. . . . .—Very brittle and soft, and interwoven with very minute spines.

30. — *acicularis*. .—White, solid, porous and scabrous externally; with fibres in fasciculæ converging to the centre.

II. Subpediculated masses, contracted toward their base; simple or lobated.

31. *S. angulosa*. . .—Sides angular; various, unequal, and numerous foramina on the edges of the angles.

Species.

32. *S. pluriloba.* .—Lobes erect and fissured; numerous small pores with interspersed round ones.

33. — *rimosa.* . . .—Lobes erect, fibrose and rather woolly; surface hollowed out with longitudinal grooves.

34. — *penicillosa.* —Surface bristled with brushes of straight and hard fibres.

35. — *turgida.* . . .—Substance fibrous; fibres loosely interwoven with a terminating foramen.

36. — *bombycina.* .—Ventricose; many lobes on the upper surface; fibres naked and lax; harsh and hispid at the surface.

37. — *flammula.* . .—Lobes erect, of an ovato-lanceolated form; fibres loose.

38. — *myrobolans.*—Mass oval, rather flat.

39. — *pes leonis.* . .—Pedicle short, sustaining a roundish, oval, soft compressed mass; texture very porous.

40. — *anatipes.* . . .—Entirely fibrous; longitudinal fibres stronger than the transverse ones; the meshes of the net-work elongated; pedicle hard and porous.

41. — *rubra.* . . . . .—Reddish, depressed, subrotund, with elevated tubercles; and pores of equal size.

42. — *peziza.* . . . . .—Yellow and ramous, branches resembling the peziza.

43. — *nigra.* . . . . . —Globose, smooth; black externally, internally of an ash-colour.

III. Pediculated masses; flat, flabelliform; simple or lobated.

44. *S. plancella.* . . .—Truncated oval form, flat; not thick; curved on one of its edges; tissue lightly encrusted, and finely porous.

Species.

45. *S. pala*. . . . . . . —Spatuliform; openings round on its upper margin.

46. — *flabelliformis*.—Fan-formed; elegantly reticulated, with superficial undulating stripes, decussating on the disk.

47. — *pluma*. . . . . —Finely fibrous, spread fan-like.

48. — *carduus*. . . . . —Dilated like a fan; with lamellated wrinkles on both sides, and echinated with spines.

49. — *pannea*. . . . —Flabelliform, with a cloth-like texture.

50. — *fissurata*. . . . —Fan-formed, more or less lobated, and covered with small irregular crevices.

51. — *cancellaria*. . —Low, flabelliform, compressed; ramifications coalescent, disposed in a trellised form, and bristled on the edges.

52. — *lyrata*. . . . . . —Erect, compressed, fan-formed lobes, with connected tubes; upper margin rounded and set with foramina.

53. — *deltoidea*. . . . . —Erect; truncated in the upper part; (frequently encrusted with vermiculæ on both sides.)

54. — *sartaginula*. . —Circular and smoothish; concave on one and convex on the other side; with small round foramina disposed almost in rows.

55. — *appendiculata*.—Subpediculated, oblong, spatuliform, with finger-formed appendices.

IV. Concave expanded masses; cup or funnel-formed.

56. *S. usitatissima*. . —Turbinated; soft, tomentous, very jagged and porous.

57. — *tubulifera*. . . . —With tubuliferous lobes.

58. — *stellifera*. . . . —Cup-formed, with thickly set stelliform pores in the hollow part.

Species.

59. *S. striata*. . . . . —Funnel-formed, with rough longitudinal striæ on the sides.

60. — *campana*. . . . —Bell-formed, with lamelloso-reticulated sides.

61. — *turbinata*. . . —Turbinated, narrow and long, cavity echinated.

62. — *vasculum*. . . . —Turbinated; surface smooth, edge woolly.

63. — *brassicaria*. . —Expanded, subfoliaceous, lobes large, surface smooth.

64. — *cyathina*. . . . —Cyathiform; with small, scattered, round openings.

65. — *Otaheitica*. . . —Cyathiform; slightly lobed, with longitudinal crevices.

66. — *costifera*. . . . —Turbinated, with longitudinal ribs on the sides.

67. — *labellum*. . . . —Labelliform, like slips of paper; striated with longitudinal thread-like risings.

68. — *pocillum*. . . . —Caliciform, with fine pores and clefts.

69. — *venosa*. . . . . . —Open cyathiform, and reticulated with vein-like white, distinct fibres.

70. — *sportella*. . . . —Basket-formed; reticulated.

71. — *bursaria*. . . . —Wedge-shaped, purse-like, connected in a fan-form.

72. — *bilamellata*. . —Flabelliform, terminating in two ample straight, parallel lamellæ.

73. — *calix*. . . . . . . —Turbinated, stipitated; the substance thick and lax, internally rather gibbous.

74. — *ficiformis*. . . —Turbinated, apex open.

75. — *compressa*. . . —A compressed cone, with longitudinal fissures internally.

V. Tubulous or fistulous masses, not expanding.

76. *S. lacnosa*. . . . —Cylindrical; externally excavated by irregular and winding lacunæ.

Species.

77. *S. tubæformis*. .—Long simple tubes, tuberculated externally.

78. — *fistularis*. . . .—Long, aggregated, simple tubes, gradually enlarging.

79. — *plicifera*. . . . —Approaching to the infundibiliform, with external, tortuous anastamosing plicæ.

80. — *scrobiculata*. .—Oblong top-form; with unequal furrows and roundish cells.

81. — *vaginalis*. . . .—Oblong and tubular; the outer surface with rough, flattish tubercles.

82. — *digitalis*. . . . —With longish processes, slightly connected; the surface muricated and ragged.

83. — *bullata*. . . . .—Branched, tubulous, with inflated nodes, and terminating in points.

84. — *syphonoïdes*. .—Tubes elongated in the form of a syphon.

85. — *colus*. . . . . . .—Erect, clavelliform, and tubular.

86. — *tubulosa*. . . .—Full of tubes, branched, erect and slender at the end.

87. — *muricina*. . . .—Subramose tubes, every where muricated with acute tubercles.

88. — *confederata*. .—Formed of many connected tubes.

89. — *intestinalis*. . —With many hollow, unequal lobes.

90. — *coronata*. . . .—Minute, a tube crowned with radiating little spines.

91. — *tubularia*. . . .—Sessile, compressed, porous, with longitudinal tubules.

92. — *ciliata*. . . . . —Conical, bending tube, becoming smaller upwards, and ciliated at the apex.

VI. Foliaceous masses; divided in flat, leaf-formed lobes.

93. *S. perfoliata*. . .—Plain stalk, with round foliaceous lobes, disposed spirally on the stalk.

Species.

94. S. *pennatula*. . .—With erect, rounded, wedge-formed, foliaceous lobes, very porous.

95. — *cactiformis*. . —Ramose; with flat, flabellated expansions rounded or muriated at the summit, and small dispersed excavations on one face.

96. — *crispata*. . . . —With contorted, bubbly, suppellucid, curled, coalescent expansions, of very fine fibrous texture.

97. — *basta*. (panache noir).—Black, fibrose, frondose-cristated; with separating convoluted folds of loosely connected fibres.

98. — *lamellaris*. . . —Sessile, frondose, with many soft, erect, and nearly parallel lamellæ, broadest in the upper part.

99. — *endivia*. . . . . —In soft spatuliform thin plates, wrinkled on their edges and surface.

100. — *urceolus*. . . —Green, obovate, narrow and ragged at the top.

101. — *mamifleris* . . —Of different forms; cavernous, with conical bending tubes, with elevated tubular pores.

102. — *polyphilla*. . —With pediculated fronds; with convoluted plaited lobes and longitudinal fibres.

103. — *pavonia*. . . . —With sub-proliferous, roundish fronds; with foramina on one side.

104. — *scariola*. . . . —With foraminated expansions, dividing in a multitude of plates, lobated, turned, and as it were crimped, in various directions.

105. — *heterogona*. . —Expansions, so turned as to form imperfect tubes.

106. — *thiaroides*. . . —Many narrow erect lobes, emulating a muricated crown.

Species.

107. S. *xerampelina*.—Ramose, with ovate incised fronds, with a tow-like incrustation.

108. — *juniperina*. . —Ramose, fronds with the fibres arranged like a lattice work.

109. — *raphanus*. . .—Substance like tow, and porous; with ovate frond-like lobes, with longitudinal grooves and wrinkles on both sides.

110. — *mesenterina*.—With broad lamellæ, plaited in winding forms.

111. — *leporina*. . . —Frondose, deeply fringed; dilating and sublobated towards the apex.

112. — *laciniata*. . . —Frondose, with many erect aggregated jagged lyre-formed lamellæ.

113. — *frondifera*. . —Slightly ramifying, with roundish, proliferous lobes, the limb fimbriated with curled fibres.

114. — *fimbriata*. . . —Slightly ramifying, with ovato-subrotund fronds, the limb fimbriated with curled fibres.

VII. Branched masses, phytoidal or dendroidal; the ramifications distinct.

115. S. *arborescens*. —Ramose; branches subcompressed; apex palmated, digitiform.

116. — *virgultosa*. . —Branches roundish; with erect twigs, rather pointed.

117. — *longicuspis*. .—Base, a trellisse formed of 5 or 6 meshes; whence rise from 6 to 9 straight long branches, sometimes coalescing, forming thin digitations or long points.

118. — *asparagus*. . —Ramose, erect, many stems.

119. — *dichotoma*. . —With erect, round, subulated dichotomous branches.

120. — *echidnea*. . . —With erect, rigid branches, all over muricated.

Species.

121. S. *muricata*. . .—Thinly branched; substance like cork; branches cylindrical, and beset with obtuse shaggy tufts.

122. — *vulpina*. . . .—With ramose lobes, rather latticed, with compressed papillæ.

123. — *spicalifera*. .—Branches erect, sub-cylindrical tubercles, muricated with spiculæ.

124. — *carlinoides*. .—Thickly branched; angulated branches, with subspinous and membranaceous expansions.

125. — *amaranthina*.—With compressed, divided and lobated branches, dilated upwards, and longitudinally striated.

126. — *strigillata*. .—Flabelliform, flat branches, with echinated papillæ.

127. — *nervosa*. . . .—Branched fan-like; nervous sub-reticulated branches.

128. — *rubispina*. . —Branched fan-like; with divided branches, rather coalescent; echinated with pointed tubercles.

129. — *abietina*. . . .—With stipitated, flat, incrusted branches, with acute papillæ terminating in threads.

130. — *elongata*. . . —Sub-ramose, with a few rather cylindrical branches; with very long naked and sub-reticulated fibres.

131. — *selaginea*. . .—Compressed, ill-formed branches; with frequent spinous keel-like ridges.

132. — *aspericornis*.—Rather round, elongated, and aculeated branches.

133. — *hispida*. . . .—Ramose, ill-formed, hispid with subulated jags.

134. — *serpentina*. .—Round branches, the smaller contorted in various directions.

135. — *oculata*. . . —Compressed, roundish, with bifid and trifid ascending branches, with eye-like openings.

Species.

136. *S. botellifera*. . .—With erect, tuberculated, grooved and ill-formed branches.

137. — *palmata*. . . .—Branched and palmated; digitiform smaller branches, with forked terminations.

138. — *lanuginosa*. —Dichotomously branched, rather compressed previously to being divided, woolly, and formed of very fine naked fibres.

139. — *typhina*. . . .—Ramose; with round, erect, woolly branches.

140. — *tupha*. . . . . —Ramose; with cylindrical obtuse omentiform branches.

141. — *fornicifera*. . —With flat, small villous ramifications coalescing in a vaulted lattice.

142. — *semitubulosa*.—With numerous cylindrical and tortuously divaricating branches, some tubular and pierced.

143. — *alicornis*. . . —With many stems; branches compressed and subdichotomous; the apices attenuated; the fibres minute.

144. — *damæcornis*. —With compressed porous branches, with clefts on one side; apices palmated.

145. — *caudigera*. . —With forked lobes; the last being very long and caudiform.

146. — *loricaris*. . . —Loose branches, narrow like straps; a little compressed, divided and irregularly curved.

147. — *cancellata*. . — Ramose, flabellated, and incrusted; with round flexuous branches, forming, by coalescing, cancellæ; the surface finely reticulated.

148. — *stuposa*. . . . —Ramose, round; towey and villous; short and obtuse branches.

149. — *linteiformis*. —In a rounded bush-like form; the branches rather narrow, jaggedly fringed, rough and sharp to the touch.

Species.		
150.	*S. clathrus*	—Many branches, crowded together, and by coalescing forming cancellæ; the apices obtuse, and rather turgid.
151.	— *coalita*	—Dilated base, inclosing other bodies; numerous roundish, compressed branches; fibres closely applied at the surface.
152.	— *faveolaria*	—With elongated, sub-cylindrical, coalescent branches; the apices conical; the surface unequal; having little pits on the surface, and being rough on the edges.
153.	— *macrodactyla*	—With long round compressed finger-like processes.
154.	— *botryoides*	—With oblong, ovate lobules, apices hollow and open.
155.	— *radiciformis*	—With tortuous, dichotomous branches, compressed at the apex.
156.	— *prolifera*	—Palmated, with frequent divisions, and distinct finger-formed processes.
157.	— *ossiformis*	—White, subramose; apex thickened and jagged.
158.	— *membranosa*	—With cellular membranes, externally muricated.
159.	— *fulva*	—Amorphous and subramose.
160.	— *floribunda*	—Confluent, with ramose fasciculi; having a chaffy flosculent down, and being obtuse and thicker at the apex.
161.	— *baccillaris*	—Erect, caulescent; with porous branches, applied to each other.

The existence of fossil sponge in the transition or in the mountain limestone has not been ascertained, or in the different beds of the lias formation; but the tenuity, in general, of its substance, and the nature of the matrices in which it has been sought, may perhaps occasion its concealment. Of its presence in the several oolitic beds, I have not been able to acquire any satisfactory information, except that in the Portland freestone I have seen semi-sphæroidal masses, about eighteen inches in diameter, divided into flattish, foliaceous, laciniated, erect lobes, and which appear to possess a spongeous structure. Specimens are sometimes found in the green sand formation, but not so frequently as may have been expected: the specimens which are most frequently found, are, I suspect, those which are adherent to the accompanying fossil shells.

The richest collection which is known of these fossils is, I believe, that of the gravel pits of the iron sand at Farringdon, where they are found mingled with the fossils of some of the early formations. Some of these specimens are of considerable size, and are in such excellent preservation as to allow, at least, of their arrangement under the more comprehensive divisions of the genus. Among the specimens are round and cavernous, resembling sp. globosa; pediculated, subpediculated, lobated and flabelliform, ramous, foliaceous, cyathiform, funnel and ficiform. In most of the specimens the structure and form of the animal are so obvious, as to raise the hope that the determining of their specific characters, and their consequent arrangement by some zealous investigator of these interesting relics, may be expected.

Fossil remains of this substance are frequently found in the chalk, and most numerously perhaps in the lower series of this formation; but from the delicate texture of the membrane of the sponge, and from its cavities being filled by the chalk itself, there are no means by which the fossil can be extricated from its matrix. Indeed, it frequently happens that these substances, agreeing as to colour with the chalk, would exist there undetected, but by the greater degree of hardness which it possesses, and by the asperities which it presents at the surface. They are sometimes pointed out by the strong tint which they derive from having sustained a ferruginous impregnation; and in these instances, although a sufficient separation from the surrounding chalk to allow the developement of the form cannot be obtained, yet, by their being carefully rubbed down to a smooth surface, something of this may be discovered, with, generally, a tolerable display of the internal structure.

The nodules of chalk flint frequently contain the silicified remains of sponge, and in a state which will allow their form and structure to be much more easily traced than in the chalk itself. The most common forms in which these occur are oblong or nearly globular: and they are either imbedded in the chalk, or scattered on its surface, or in the neighbouring declivities. These may be frequently found on the Sussex downs, the Gogmagog hills of Cambridgeshire, and, indeed, on or about most of the chalk hills. These nodules appear to have been formed round fragments of sponge of different forms and structure, and to be more or less filled, according to the degree of decomposition and subsequent removal which the included substance had sustained after its inclusion. In some specimens, particularly among those of Wiltshire, which have been collected by the liberal encouragement of Miss Benett, a tuberous or ramified body, and, in some instances, two such bodies, are extended across the cavity of the flint, and covered over with a fine white powder of chalk and silex blended. These bodies appear to be casts in the cavities of sponge, the substance of which has passed away. In others the substance which had been included appears to have been broken down and removed, and its place occupied by chalk which has intruded in a pulverulent state; whilst in others the cavity alone remains. Oblong nodules, found on Stokenchurch Hill, and for some distance on the Oxfordshire side, very frequently exhibit specimens, which, on being broken, display the structure of the Zoophyte in great distinctness. In the chalk marl at the foot of the cliff at Beachey head, are botryoidal and lamelliform masses, which not only from their external forms, but the appearances yielded on their fracture, lead us to the recollection of the masses of fossil sponge at Farringdon, and which, in all probability, have been yielded by the chalk marl.

Fossil sponge of a very fine texture, and in a pulvinated form, is sometimes found investing the shells accumulated in the cliffs at Walton and Harwich.

A flint stone, found on the shore at Dawlish in Devonshire, bears decided marks of its having derived its form from the siliceous impregnation of *sp. mammillaris.*

Several fossils of the tribe of Zoophytes having been noticed in a former work, which, although not possessing the decided characters of the genus, were still, with expressed doubt, placed among the Alcyonia; an attempt at a better classification of some of these bodies is here attempted.

The first of these, are those bodies which are distinguishable by bundles of tubuli passing through a spongeous substance, and which may be thus characterised.

Siphonia.—A fossil animal, with a polymorphous body, supported by a stem proceeding from a fusiform or ramose root-like pedicle; the original substance spongeous, and pierced by a bundle of tubes derived from the pedicle, passing through the stem, then ramifying and terminating on the surface of the body.

The various spongeoid fossils, bearing the forms of cups, funnels, fruits, &c. described by M. Guettard, as obtained from Verest, near Tours and Saumur, and at Montrichard, in Touraine, and by the Rev. J. Townsend, as found in the green sand of the Vale of

Pewsey*, as well as those which are figured, *Pl.* IX, *fig.* 1, 4, 5, 7, 11, 12, 13, *Pl.* X, *fig.* 6 and 13, of the second volume of Organic Remains, &c. are of the same genus.

Since the publication of the last mentioned work, Mr. Webster made the discovery of those interesting fossils in the Isle of Wight, which from their long seeming stalks, and from their tulip-formed superior terminations, obtained the name of tulip alcyonia†. These fossils decidedly agree in the characters which have been assumed for this genus.

Soon after the discovery of these fossils, Miss Benett, whose exertions have much aided this department of Natural History, favoured the Geological Society with a suite of drawings, and of fossil specimens of various forms, but decidedly of this genus, which had been found in the sand, chiefly in the neighbourhood of Warminster. This valuable collection is rendered extremely interesting, by the great variety of forms which these fossils have assumed; cylindrical, straight, ramified, round, oblong, ovoid, wide and narrow, short and long, cup or funnel-formed; elongated like a cucumber, as in Organic Remains, Vol. II, *Pl.* X, *fig.* 6; tulip-formed, exactly agreeing with those discovered by Mr. Webster, and assuming also the forms of *spongia turgida, sp. alcicornis* & *damicornis,* and indeed many other of those forms which sponge offers to our observation. Among the most interesting specimens are those which are lobated, and in which from two to five or six lobes, closely united together, are found upon one stem; and in one specimen, two stems arise from the same base, one of which terminates with three and the other with four lobes*.

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* The Character of Moses, &c. *Pl.* I, *fig.* 1, *Pl.* II, *fig.* 1, 2, 3, *Pl.* III, *fig.* 1, 2, 3.

† Geological Transactions, Vol. II. The importance of this discovery of Mr. Webster will be observed, when it is considered that the remains of this animal, known perhaps only in this formation, are found in considerable numbers in the Leith Hill of Surry, in the green sand of Wiltshire, Devonshire, &c. and in the free-stone of Portland, approximating to the green sand.

Flints are sometimes found of a roundish form, pierced internally with numerous tubules passing in every direction, and giving the idea of the flint having invested a small hispid leafless shrub. It is extremely probable that these fossils may have originated in a species of this genus, bearing this form, and having the tubuli thus radiating through the spongeous part; the siliceous impregnation having solidified this part, and left the tubules unfilled.

It is not to be doubted that, when the specific distinctions of the several specimens belonging to this genus have been ascertained, the number of its species will be found to be very considerable*.

At *Pl.* I, *fig.* 8, is represented a transverse section of one of the stems of a tulip-formed specimen, in which the bundle of tubules are shown; and at *fig.* 7, the superior extremity of the same fossil is given, with the numerous terminations of the tubuli. These may be also generally discovered on the sides of the depression or cavity which sometimes exists in the superior termination.

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* From the account given by Miss Benett to the Geological Society, respecting these fossils, it appears, that they are found in the Valley or Common of Warminster, in the reddish yellow sand, at a depth seldom exceeding two feet, on the sides of the hills. At Whitburn near Claythill, in the same neighbourhood, the green sand comes to the surface, and these fossils are found in it. At Boreham, on the east side of Warminster, the grey sand is uppermost, and there, but most rarely, are found fossils of the same kind. "These fossils," it is observed by Miss Benett, "appear to belong to the top of the sand formation, without regard to the sort of sand. The yellow sand appears to be the grand depot of them: in the green sand, large specimens predominate; but those of the grey sand are in a higher state of preservation." These fossils were discovered by Mr. George Warren of Warminster, to whom Miss Benett states herself to be indebted for them.

The existence of these animals appears to have been confined to that sea from whose waters the green sand formation was deposited; no traces of their remains being mentioned as found in the strata of any of the preceding or subsequent formations.

Animalisation has, in this genus, proceeded a degree beyond that in which it exists in sponge; since, added to the spongeous texture, is the bundle of tubes which has been here considered as yielding its generic distinction.

In the fossils next to be examined, a different and more distinct kind of organisation is discoverable: tubes here exist also in considerable number, and are connected by transverse intercurrent tubules. The organisation existing in this animal seems to authorise its being placed in a distinct genus; and it is presumed that the designation which is here assumed for it will not be disapproved.

Mantellia.—An animal with a fusiform or ramose, root-like pedicle, a stem and body formed of tubuli, anastomosing in a basket-like texture, with openings on the internal surface.

The most common species of this genus is the fossil which has been described by Mr. Mantell, as a species of Alcyonium*. But whilst removing this fossil from the genus under which Mr. Mantell had placed it, it must be observed, in justice to this gentleman, that it had been stated by the present writer, that "although I shall in general speak of these bodies as alcyonia, I am aware that, when their histories have been elucidated by the inspection of more illustrative specimens, several of them may claim other designations†." In conformity with this opinion, Mr. Mantell chose to speak of this body as an alcyonium; his judgment, at the same time, directing him to do it with due reserve; he also "wishing it to be allowed only a temporary admission into this situation, till future discoveries shall point out more precisely its situation in the scale of animated nature."

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* Description of a fossil Alcyonium from the chalk strata, near Lewes. Transactions of the Linnæan Society, Vol. XI, 1815, Part 2, page 401.

† Organic Remains of a former World, Vol. II, page 89.

The specimen *Pl.* I, *fig.* 9, reduced from Vol. II, *Pl.* XI, *fig.* 1, of Organic Remains, belongs to a species of this genus, and appears to have been part of a stem. In this species, it will be observed, that the transverse anastomosing vessels are but few, and smaller than those which proceed in a perpendicular direction. In the specimen *Pl.* I, *fig.* 10, reduced from *Pl.* XI, *fig.* 6, of Organic Remains, the characteristics of the genus are more decidedly shown, the intervening vessels are much more numerous, and approach nearly in thickness to those which they connect. In other specimens depicted in the work just referred to, the characters of other species may be perceived; thus in Organic Rem., Vol. II, *Pl.* XI, *fig.* 3, the anastomosing is formed by the oblique arrangement of the tubuli; and in *fig.* 7 of the same plate the same effect is produced by the very frequent ramifications and inosculations of the vessels. It is indeed extremely probable, from the appearance of numerous imperfect specimens, that the industrious collector will be enabled to place many more species under this genus.

The remains of this genus are almost all confined to the chalk; but in one or two specimens, appearances are observable which lead to the supposition that they may have been deposited in some part also of the chalk marl.

Alcyonites.—There are very few animals to which we can have access in their living state, whose nature and structure are so little understood as the Alcyonium; and hence have arisen considerable difficulties when examining them in their fossil state. The definition and descriptions of M. Lamouroux, with the observations which he has made on their structure, are so likely to yield useful information in the examination of their fossil remains, that I feel no hesitation in introducing them.

"*Alcyonium.*—A polymorphous polype bearing animal, formed of a fleshy animated mass, sometimes inert, sometimes sensible, and filled with retractile polypi which expand on its surface. In the dry state this mass appears composed of fibres reticulated and interlaced at the centre, radiating to the circumference, and covered with a firm cellular, coriaceous or cretaceous covering*."

The number of tentacula are said to vary in different species, but M. Lamouroux only examined the polypes of *Alcyonium lobatum*, and found them not to agree with those attributed by Dr. Solander and Dr. Spix to this species.

In the following catalogue, as in that of the sponges, the most obvious characters, and those which are most likely to be detected in the fossil, are particularised.

1. *Alcyonium arboreum.*—With papillary pores disposed in lateral and terminal tuberosities.—*Gmelin*, p. 3810, n. 1.
2. *A. palmatum.*—With a simple stem, subramous, and papillous at the extremity.—*Marsilli, Tab.* XV, n. 74, 75.
3. *A. lobatum.*— With a grey, tuberous crust; lobated; with numerous impressed pores.—

    1. *A. digitatum*, or dead man's toes of *Ellis, Coral. Tab.* XXXII, a. : . A. a.
    2. *A. exos.* Spinx, *An. du Mus.* Tom. XIII, *Tab.* XXXIII, *fig.* 8 to 14.

4. *A. rubrum.*—Red, soft, and encrusting; entirely covered with points or stars with eight rays.
5. *A. cydonium.*—An oval or elliptical mass, convex above, concave beneath, irregularly grooved and notched; cells discoverable if the skin is not injured.
6. *A. massa.*—Irregularly shaped.

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* Histoire des Polypiers Coralligenes flexibles, &c. par J. V. F. Lamouroux, A. Caen, 1816, p, 317.

7. *A. cidaris.*—Fixed, globose, and hard; excavated by tortuous sinuses; terminal depression large; frequent, small, substellated openings.—*Donat. Adr.* p. 56, *Tab.* IX.
8. *A. vesparium.*—Fixed, erect, large, ovato-oblong; apex, obtuse; internally cavernous; many minute openings.
9. *A. incrustans.*—Lobated; spongio-fibrous within; numerous small substellated pores.
10. *A. serpens.*—Fleshy, tape-like; tortuously creeping; with wart-like prominences with subradiated openings.
11. *A. trigonum.*—Carnous, cellular, subtrigonal, covered all over with small openings.
12. *A. foratum.*—Oblong, smoothish; surface subreticulated; foramina rather large and scattered. *Spongia?*
13. *A. cribrarium.*—Coriaceous, widely incrusting.
14. *A. phalloïdes.*—Pedicle short and thick, supporting wide tortuous lobated branches, heaped in a dense mass, with small scattered oscula.
15. *A. pyramidale.*—Cylindrico-conical; red and fleshy within.
16. *A. pulmonaria.*—Pulpous, olive-coloured and livid; compressedly lobated; covered with very small stellated oscula.--*Ellis Corall.* p. 97, n. 1, *Tab.* XVII, b, B, C, D.
17. *A. lyncurium* (Orange du mer).—Globose, fibrous, yellow, warted. — *Planc. Conch. Min.* 2, p. 44, app. 2, p. 114, n. 3; *Marsil.* p. 82, *Tab.* XIV, n. 72, 73.
18. *A. alburnum.*—White, very branched, thin, subdivided, with tubular-terminal pores.
19. *A. plicatum.*—Wide, rounded, lamelliform, with thick lamellæ windingly plaited, subcristated, with minute scattered foramina.
20. *A. sinuosum.*—Lamellated; erect, thick lamina, tortuously winding like the folds of the brain, with numerous marginal openings. *Spongia?*
21. *A. manus diaboli.*—Polymorphous, perforated, with obtuse protuberances.
22. *A. diffusum.*—Very ramose, diffused and ill-formed.
23. *A. sceptrum.*—Long, cylindrical, obsoletely clavated.

24. *A. ensiferum.*—Long branches, rather flat and bent like a sabre.

25. *A. junceum.*—Very long, roundish, but compressed, soft branches.

26. *A. quercinum.*—Frondose, with flat, winding, lobate processes.

27. *A. asbestinum.*—Stem reddish, nearly cylindrical, beset with oblong pores, set in quincunx order.

28. *A. cranium.*—White, tuberous, set with *setæ.*

29. *A. papillosum.*—Sessile, incrusting, and variously lobated and papillated with spinous tubercles and echinulated interstices.

30. *A. tuberosum.*—Tuberous, yellowish: tops often subdivided; set with tubular pores.

31. *A. ficus.*—Fig or pear-formed; tuberous, rather ovate; pulpy and livid.—*Mars.* p. 87, *Tab.* XVI, n. 79.

M. Lamouroux observes that there is reason for believing that there exists in the Mediterranean two bodies of the same figure: the one belonging to sponge, the other to alcyonium. Solander considers that figured by Ellis to be sponge.

32. *A. cylindricum.*—White and round.

Lamarck considers this as only being a detached portion of a ramose alcyonium.

33. A. *radicatum.*—Substance homogeneous, like cork; with very small scattered pores; base divided by many clefts. No bark discoverable.

34. *A gelatinosum.*—Cylindrical or compressed, pellucid and watery within, irregularly compressed and branching.—*Planc,* ed. 2, p. 115, c. 29, *Tab.* X, A; *Ellis, Cor.* p. 102, n. 5, *Tab.* XXXII, *fig.* dD.

In Parkinson's Herbal, he considers it as a sponge: others have thought it an ulva or sucus.

35. *A. pappillosum.*—Encrusting, covered with large convex papillæ.—*Mars.* p. 86, *Tab.* XV, *fig.* 76-78.

36. *A. distomum.*—Encrusting, with red scattered papillæ, each with two openings.

37. *A. gorgonoides.*—Ash-coloured, flesh mixed with sand; radiated wart-like cells.—*Solander* and *Ellis,* p. 181, n. 8, *Tab.* IX, *fig.* 1, 2.

38. *A. corniculatum.*—Four stellated pores surrounding a central papilla, with four erect terminal crescents.

39. *A. stellatum.*—Terminations distinguished by two stellated cells.
40. *A. fluviatile.*—Encrusting, polymorphous; set with pentagonal tubular pores.

The following compose the second section of the Alcyonia of Lamarck, who distinguishes them from the former by the openings of the cellules not appearing on the dry specimen. M. Lamouroux considers them as doubtful, and perhaps as intermediate between the Alcyonia and the Sponges.

41. *A compactum.*—Tuberous, globoso-pulvinate; surface smooth.
42. *A. medullare.*—Lamarck assumes for this species the synonymous alcyonium of *Ellis, Cor. Tab.* XVI, *fig.* D, d, D 1.
43. *A. testudinarium.*—Elliptical; rather flattened convex, spread, slightly reticulated, with many dorsal ridges, with slightly interrupted cristæ.
44. *A. orbiculatum.*—Compressed, rounded, thick; surface rough and very porous, unequal sized pores.
45. *A. radiatum.*—Circular; upper surface concave, smooth, folds radiating to the margin; with about six conoidal tubercles; lower surface convex, radiated with fibrous costæ.
46. *A. cuspidiferum.*—Sessile, erect, hollow; slit upwards in many long, straight, sword-shaped lobes, with a surface very slightly porous.
47. *A. granulosum.*—Hemispherical, gelatinous, semipellucid; raggedly grooved underneath; surface granulated and wool-like.
48. *A. putridosum.* — Ventricoso-globose, somewhat pear-shaped; thin at the edges and slightly reticulated; surface set with tubular openings.
49. *A. purpureum.*—Of an intense purple; flattish, carno-spongeous; surface smooth.
50. *A. boletus.*—Substipitated, clavated; internally, ramose fibres latticed with dilated lamellæ; surface incrusted, porous and tuberculated.
51. *A. boletiforme.*—Sessile, simple, rounded; flat on one side, convex on the other; with small tubercle-formed risings sprinkled with small cells.

Although difficulties may attend the attempt to arrange, by these characters, substances so vaguely formed as the alcyonia, especially those which exist in a fossil state; yet it will be found that the above table will afford considerable advantage to the student of fossils. He will by a comparison with the characters of the species as there given, and by attention to the following observations, gain a nearer approximation to the true character of the substance under examination, and will be frequently enabled to give to it a name and place.

Difficulties must frequently arise whilst endeavouring to make the required distinctions in fossils of this kind, arising from the inability which is frequently found of ascertaining, in fossil specimens, the nature of its texture; it sometimes happening that no assistance can be yielded either by the form of the fossil or by the appearance of its surface. The ambiguity arising from the form depends on the fossils of this genus being sometimes found under the same specific forms which belong also to Spongites, Syphonites, and Mantellites: this is particularly the case with the cyathiform and fructiform species, which may be found in all these genera.

There are therefore four distinct genera under which fossils bearing the same general forms may be placed; and the characteristic marks of each genus will, in general, be found sufficiently evident on their surfaces to mark the situations, which, in classification, each of them should hold.

If a cellular texture, such as would be formed by the irregular decussation of membranous substance, can alone be traced, without any appearance of tubuli, the place of the fossil would appear to be under the genus *sponge;* but if, in addition to the spongeous texture, straight or regularly divaricating simple tubuli should appear, its place would be under *syphonia*. If, whether spongeous texture appear or not, simple tubes are discovered connected laterally either by anastomosing or intercurrent tubules, the fossil may be considered as belonging to *Mantellia;* but should the more compact part of the fossil, or its porous surface, display the evident labours of polypes, no doubt should be entertained of placing it among the species of *Alcyonium.* This may be instanced, as has been just mentioned, in those fossils which bear the forms of fruit: in sponge, is *Sp. ficiformis*; in syphonia, a correspondent form frequently occurs; in Mantellia, the fossil figured, *Organic Remains*, Vol. II, *Pl.* XI, *fig.* 3, may be instanced; and in *Alcyonium,* is both *A. ficus* and *A. cydonium.*

Although M. Lamouroux has not thought proper to reject from the preceding table several bodies which have been considered as Alcyonia, he is himself of opinion, that the number should be much diminished: considering those only as Alcyonia which are evidently the production, and have been the habitation of polypes. He accounts for Lamarck having intermingled and confounded these animals, by his having too frequently judged of them from the dry specimens; but is of opinion that they may be readily distinguished either in their living or dead state.

In the recent alcyonia, the polypes or their cells may be always seen on taking them out of the sea; but nothing similar is discoverable in sponges. In the alcyonia not only is that pulsatory motion observable which is attributed to sponge, but, in those alcyons which are ramified, the branches are sometimes seen to be curved and afterwards straightened again. This is particularly observable in *A. lobatum.* The difference between the two animals is also apparent on the examination of the dried specimens. On a section, either transverse or vertical, being made of dried sponge, no difference of substance is discoverable; from the centre to the circumference is the same organisation; but on making a section in any direction through the centre of the dried alcyonium, a structure more or less fibrous, and a substance more or less grooved, will be seen passing from the centre to the circumference, and on the surface will be found a distinct skin or bark-like covering, with numerous foramina, some of which are hardly perceptible. These foramina appear to be the openings of the radiating fibres, or tubes rather, and in some species are very evident.

To endeavour to trace the fossil remains of Alcyonia to the strata in which they were originally infixed, has hitherto been accompanied with but little success: this has been partly owing to the incorrect accounts which have been given, respecting these and similar substances by the earlier writers on fossils: and partly to the difficulty of discovering these fossils when imbedded in stone, in the more obvious characters of which they are likely to participate, and thereby become more difficult of detection.

The fructiform figures which the spongeoid fossils so frequently possess, had obtained for them, to a late period, the names of those fruits which it was thought they most nearly resembled; and even when, in a former work, the present writer removed these substances from the vegetable kingdom, he was still unable to discover in them such characters as would allow him to decide which specimen should be considered as sponge and which as an alcyonium. It is a remarkable circumstance, and not easy of explanation, that, after numerous eager examinations with powerful glasses, he has never seen, to his knowledge, the characteristic radiating or decussating fibres of the internal part of the Alcyonium. In the fossils represented, *Organic Remains*, Vol. II, *Pl.* XI, *fig.* 4 and 8, where the appearance of a cortical substance led to the belief that these substances are of alcyonic structure, and although the specimen, *fig.* 4, in particular, possesses such a degree of transparency as allows the discovery of organic structure, in that part which is connected with its cortical covering, no appearance of fibres can be discovered.

But the establishment of the genus *Siphonia*, it is hoped, will considerably assist in the required arrangement of this class of fossils: the obvious tubular structure in the fossils of this genus will readily enable the student to effect their separation from those of Spongia and Alcyonium: and in consequence of this abstraction, it will in future be only required to determine to which of these two genera the remaining ambiguous fossils of this class are to be attached; or failing in this, to endeavour to detect in them the characters of some undescribed genus.

With respect to the ascertaining of the stratum or even the formation to which the alcyonic fossils belong, little more than negative information can be given. It does not appear that they exist among the *Syphonia* in the green sand; none having been spoken of as existing in the rich mines of Warminster, in the Portland freestone, or in the Black-down hills of Devonshire.

Some fossils, which have been considered as belonging to this genus, have possessed appearances which have led to the suspicion that they had been imbedded in some of the strata of Oolitic formation; but no positive evidence has been adduced of their having been found in such situations; nor do any statements appear to have been made of their remains having been detected in any of the subjacent formations of lyas, mountain limestone, &c.

It is from the examination of the matrix of some fossils apparently of this genus that the conjecture is offered that the chalk marle is the stratum to which the alcyonia more peculiarly belong.

Tethia. A tuberous, subglobose polypifer, fibrous within; the fibres rather fasciculated; divaricating or radiating from the centre to the periphery, and glued together by a small portion of pulpy matter; cells in a cortical crust disposed to fall off.

The characteristic difference of this genus, and by which it is proposed to separate it from Alcyonium, is the diverging, radiating, internal fibres, being collected in fasciculæ.

From the description of this genus and of some of its species, there does not appear to be any reason for supposing that it may not be as susceptible of those changes on which petrifaction depends, as some of the species of Alcyonia are known to be. Fossils indeed, resembling in form *Tethya lyncurium,* (Orange du Mer) figured by Marsilli, Donati, and Esper, are not infrequent among the assumed fossil remains of Alcyonia.

Geodia. A free, carnose, tuberiform polypifer, hollow and empty, and firm and hard when dry; the outer surface being all over porous; and has on the side a separate circular area, pierced with larger pores.

This animal is perhaps described only by Lamarck, who has seen but one specimen of it, which he purchased at the sale of the cabinet of M. Turgot, Governor of Guiana: nothing has been stated respecting its existence in a fossil state.

Palythoa.—M. Lamouroux has very properly formed a genus for the reception of two animals which Solander had placed among the Alcyoniums, but which differ from that genus in manifesting more complexity of organisation; the cavities, which are distinct, are divided by longitudinal lamellæ, being each appropriated to a single polype.

Palythoa.—A polypifer, flat, covered with numerous, cylindrical, united mammillæ, of more than a centimetre in height, with isolated cavities or cellules, almost longitudinally chambered, and each containing a single polype.—*Lam.*

Sp. 1. *P. mammillosa.*—The polypiferous cellules with a stellated opening.—*Sol.* and *Ellis*, p. 179, n. 5, *Tab.* I, *fig.* 4, 6.

Sp. 2. *P. ocellata.*—Rugous mammillæ; opening stellated and radiated.—*Sol.* and *Ellis*, p. 180, n. 6, *Tab.* I, *fig.* 6.

A sketch of this species in its recent state, from *Ellis*, is given *Plate* I, *fig.* 14.

One specimen has been seen by the writer which he considered as the fossil remains of the second species; it possessed the general external characters, and also had the peculiar ochraceous appearance which is attributed to it by Solander.

Advancing on the scale of organisation, we arrive at that division of Zoophytes in which our admiration is excited by the minuteness and elegance of forms, observable in their receptacles; the habitations of the animals appearing like minute plants of beautiful forms, whilst the animals who formed and inhabit these dwellings require the aid of the microscope to examine into their nature, and oftentimes even to discover their existence. These little architects are divided into those which form their domiciles of a soft and yielding substance, and those which have the property of secreting and depositing for this purpose a substance rapidly indurating and acquiring a hardness almost approaching to that of stone: the latter alone require attention here.

POLYPIFERS *formed like Net-work.*

Flustra.—A submembranous, flexible, lapidescent polypifer, frondescent, or expanded in a thin crust, formed by numerous rows of cells, disposed as if woven together, on one, or on the two opposite surfaces. The cells sessile, contiguous, adherent, short and oblique; the terminating mouth rather gaping, and in some dentated or ciliated.

The following are given by Lamarck as fossil species, but of which the genera appear to be doubtful*.

1. *Fl. tesselata.*—Incrusting, with septæ rounded forward; cells depressed upwards; the mouth small and nearly round.—*Desmarets and Le Sueur, Bull. des Sc.* 1814, p. 53, *Pl.* II, *fig.* 2.

   Found on the fossil bodies, such as echinites, belemnites, &c. of the environs of Paris.

2. *Fl. reticulata.*—Formed of moderately thick fronds with cells on both sides; the cells long oval; the septæ rather prominent; and the mouth rather transverse.—*Desmarets and Le Sueur, Bull. des Sc.* 1814, p. 53, *Pl.* II, *fig.* 4.

   Found in the sands of the environs of Valogne, with the baculites, belemnites, &c.

3. *Fl. quadrata.*—Incrusting and radiated, with cells formed in squares or parallelograms.—*Desmarets and Le Sueur, Bull. des Sc.* 1814, p. 53, *Pl.* II, *fig.* 10.

   On the cast of a fossil bivalve.

4. *Fl. crassa.*—Incrusting; thick; with septæ, prominent, but depressed upwards; the cells short; a large crescent-formed mouth.—*Desmarets and Le Sueur, Bull. des Sc.* 1814, p. 53, *Pl.* II, *fig.* 1.

   On a fossil oyster of Grignon.

5. *Fl. cretacea.*—Incrusting; thick; with ovately oblong cells.—*Desmarets and Le Sueur, Bull. des Sc.* 1814, p. 53, No. 6, *Pl.* II, *fig.* 3.

   On a fossil murex in the environs of Plaisance.

6. *Fl. utricularis.*—Incrusting; with rather depressed ovate cells, widest behind; the mouth small and placed forwards.—*Desmarets and Le Sueur, Bull. dec Sc.* 1814, p. 54, *Pl.* II, *fig.* 8.

   On fossil echinites of the chalk†.

In addition to these, M. Lamouroux particularises the following:

7. *Fl. bifurcata.* Foliaceous; the fronds dichotomous, with bifurcated summits, and set with hexagonal cellules on both surfaces.—*Desmarets and Le Sueur, Bull. des Sc.* 1814, p. 53, *Pl.* II, *fig.* 6.

8. *Fl. microstoma.*—Incrusting; thin; with oval, slightly convex, indistinct cells; the mouth very small and round, and placed in the middle. *Desmarets and Le Sueur, Bull. des Sc.* 1814, p. 54, *Pl.* II, *fig.* 9.

   On the large fossil oysters of Sceaux.

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* Histoire Naturelle desAnimaux sans Vertebres, par M. le Chev. de Lamarck.

† Histoire des Polypiers coralligenes flexibles, vulgairement nommés Zoophytes, par J. V. F. Lamouroux, D.E.S. *Caen*, 1816.

II. *Cellepora.*—A sublapideous polypifer, internally porous, expanded in a crust, or raised in flat, stiff, lobated or ramose, slightly convoluted fronds, bearing cells on their outward surface. The cells, rather membranous, urceolated, ventricose, close, rather projecting, and confused; the mouth constricted.

Desmarets and Le Sueur have, in the Bulletin des Sciences, already referred to, ascertained the existence of two fossil species.

1. *Cell. megastoma.* Incrusting; with very distinct ovate cells, irregularly heaped together; the mouth large, *Pl.* II, *fig.* 5.
   On chalk fossils.
2. *Cell. globulosa.* Incrusting; with distinct globulose cells, and a transverse mouth.
   On chalk fossils.

The fossil *Celleporæ* are distinguishable from the fossil flustræ, by their cells being urceolated and irregularly placed, and by the constricted appearance of the mouths.

No species of *Tubulipora* has been found fossil. They might be distinguished by their cells being longish, tubular, and not connected together by any lateral adherence; and by their mouth being round and regular.

Neither has any species of the genus *Discopora* been described as seen in a fossil state: they might be distinguishable by their form, which is that of a discoidal undulated plate, the upper surface covered with numerous small, short cells, in quincunx order, the mouth not being constricted. They differ from the tubulipores, in the cells being more sunk and less free; and from the cellepores in having no lobated, convoluted, or ramose expansions.

Eschara also has not been found fossil; its species would be discovered by their flat, lamelliform, thin expansions, with cellules in quincuncial order disposed on both sides, by which they may be distinguished from the millepores and resepores.

Adeona might be placed in the same genus as Eschara, but for its peculiar stem, which is sub-articulated and covered with a superficial crust, and its leaf-formed expansions, which are covered with cellules.

Retepora has also thin and flat expansions composed of branches sometimes free, but most frequently anastomosing in web-work or in fillets. The cells are disposed only on one side, which distinguishes it from the adeonas and escharas. It is not incrusting, which distinguishes it from the cellepores.

A fossil species has been found in the environs of Angers, in small pieces, by M. Menard, which is thus described:—*Ret. frustulata.* In flat pieces, in lattice work, with pores on one side.

Alveolites.—A lapideous polypifer, either incrusting or in a free mass composed of many concentric tables, involving each other. The tables are formed of tubulous, alveolar, prismatic, short, contiguous, and parallel cellules, connected externally in a net-work.—*Lam.*

The greater part of the substances belonging to this genus, Lamarck observes, are yet only known in a fossil state; and of these he particularises the following:

1. *Alveolites escharoides.*—Subglobose, the surface webbed with rhomboidal cells; the margin of the cells biporous.
   Found fossil, in the environs of Dusseldorf. In the cabinet of Chevalier de Lamarck. A subglobular irregular mass, as big as a middling-sized apple, formed of numerous layers, rather thin, enveloping each other.
2. *Alv. suborbicularis.* — Hemispherical; the surface perforated with oblique subimbricated cells.
   Fossil, from the environs of Dusseldorf, in the cabinet of Chevalier de Lamarck.
   These are in masses rather large; they are convex, and almost turbinated on one side; flattened and even a little concave on the other; being of irregular hemispherical shapes. The beds are of a moderate thickness, the inner ones being the thinnest; the tubes which by their union form these layers are very much inclined.
3. *Alv. madreporea.*—Oblong, smooth, subramose, and reticulated on the hollow surface.—*Guillard. Mem.* Tom. III, *Pl.* 56, *f.* 2.
   Fossil, from the environs of Dax, in the cabinet of Chevalier de Lamarck.
   This alveolite has the appearance of a long, rolled fossil madrepore, with cells, not projecting as in the Madrepora porites; but the examination of its interior part discovers a considerable difference, and shows that the mass is a compound of pentagonal and hexagonal tubular cellules, placed in layers on each other.
4. *Alv. incrustans.*—Incrusting marine bodies, the outer surface reticulated; the cells prismatic, vertical, unequal, and close together.
   Its crust is composed of a single layer of closely set tubes; the surface presents outwardly a net-work of small, unequal, pentagonal, or hexagonal meshes.

These fossils are perhaps not very frequent in this island: I know but of two; one of which appears to belong to the last species, *Alv. incrustans.* The polygonal septa dividing the meshes exist in the cavities and pass into the substance of a gravel flint, with the localities of which I am uninformed. A portion is shown, *Pl.* II, *fig.* 1.

The other is of an hemispherical form, and is, comparatively, a very large mass, being more than fifteen inches in diameter. It is composed of concentric tables, about half an inch in thickness, involving each other, and formed of alveolar, prismatic, parallel and contiguous cells. It was found in a mass of Portland stone; and by exposure to the weather has undergone such separations of its external table, as have shown its right to be considered as of this genus, and probably as *Alv. suborbicularis.*

Ocellaria.—A lapideous polypifer, expanded in a membranous form; variously convoluted and rather infundibuliform; with an arenaceous surface, porous on both sides; pores cylindrical, in quincunx order, with a solid axis in a raised centre.

These bodies have the appearance of an eschara, or a retepora; but are distinguished particularly by the solid central axis which is raised to the orifice of each pore, and forms there a species of papilla.

There are but two species, both of which are fossil.

1. *Ocellaria nuda.*—Infundibuliform, expanded and branching in various ways.—*Ramond Voyage au Mont Perdu,* p. 128, *Pl.* II, *fig.* 1, and p. 345: *Bulletin des Sciences,* No. 47, p. 177.
Found in the lime-stone of Mount Perdu in the Pyrenees.
2. *Ocellaria inclusa.*—Conical, involved in flint.—*Guettard. Mem.* Vol. III, *Pl.* XLI; *Ramond, Pl.* II, *fig.* 2; *Bulletin des Sciences,* p. 177.
Found in Artois.

Dactylopora.—A lapideous free polypifer, of a cylindrically clavated form, with a perforation in the narrower extremity. The surface reticulated with rhomboidal meshes, the net-work itself porous.

It differs from retepora, in being a loose, simple polypifer, without lobes, ramifications or frondescence. It possesses an opening essential to it. The net-work is double, interior and exterior, which unite near the opening.

D. Cylindracea.

1. Fossil. Reteporite.—*Bosc Journal de Physique, Juin* 1806.

FORAMINATED POLYPIFERS.

Stony, solid, and internally compact; with perforating or tubular cells not furnished with laminæ.

Ovulites.—A stony, free, oviform, or cylindrical, polypifer; hollow within; the extremities generally perforated, and minute pores regularly diffused over the surface.

Known only as a fossil; very small, not exceeding two millimetres in length. The openings are suspected to have proceeded from injury.—*Grignon.*

Sp. 1. *O. margaritula.*—Oval, with very minute pores.—*Grignon.*

2. *O. elongata.*—Cylindrical; the extremities truncated.—*Grignon.*

Lunulites.—A free, stony, circular polypifer, with one side convex, the other concave.

The convex side striated in rays, with interstitial pores; the concave side radiated with diverging rugæ and grooves.

Sp. 1. *L. radiata.*—The concave side with radiating striæ, the convex with pores.

Fossil.—*Grignon.*

2. *L. urceolata.*—Cupola-formed, the convex side latticed with numerous pores.

It resembles in form the cup of an acorn or a thimble.

Fossil, from Parnes and Liancourt.

It is also found in the green sand of Wiltshire.

Orbulites.—A free, circular, stony polypifer; flattish; porous on both sides, or at the margin; resembling the nummulites.

Set with minute pores, sometimes scarcely visible, regularly disposed, but not in a spiral order.

It differs from Lunulites in having pores on both sides.

1. *O. marginalis.*—With a porous margin; both sides flat.

Recent.

2. — *complanata.*—Thin, fragile, flat and porous on both sides.

Fossil.—*Grignon; Guettard, Mem.* III, p. 434, *Tab.* XIII, *fig.* 30, 32.

3. — *lenticulata.*—Upper surface convex, the lower flattish.

Fossil.

4. — *concava.*—Convex on one side, and concave on the other; surface rather rugous.

Fossil.

5. — *macropora.*—Rather flat, with the centre depressed; rather large pores on each side.

Fossil.

6. — *pileolus.*—Convex on one side and concave on the other; a groove round the margin, no pores visible.

Fossil.

Distichopora.—A stony, solid, fixed, ramose and rather compressed polypifer. The pores unequal and marginal, placed on the two opposite edges, in longitudinal rows, and in the form of sutures; stelliform; wart-like projections are scattered on the surface of the branches.

This genus is formed by Lamarck for the reception of what has been considered as a millepore, *millepora violacea* of Pallas; but which from its form, and the arrangement of its polypiferous pores, he thinks requires to be separated from that genus.

1. *Dist. violacea.*—Ramose, with flexuous ascending branches smoothly compressed.—*Pallas. Zooph.* p. 258; *Ellis and Sol.* p. 140.
Not known fossil.

Millepora.—A stony, internally solid, polymorphous, ramose or frondescent polypifer, pierced by simple, not lamellated pores.

The pores cylindrical, and perpendicular to the axis or to the expansions of the polypifer; for the most part small and sometimes not apparent.

1. With the polypiferous pores apparent.
In this class are disposed the following species of Linnæus, Solander, &c. *M. Squarrosa, complanata, alcicornis, aspera, truncata, tubulifera, pinnata,* and *rubra.*
2. With the pores scarcely or not at all apparent.—(*Nullipores.*)
Among these are placed, *M. informis, racemus, fasciculata, byssoides, calcarea,* and *agariciforme.*

None of these are represented as having been seen in a fossil state, but the separations adopted here and in the subsequent genera are too important not to be particularised, since by an attention to such distinctions fossil substances may be traced back to recent analogues little suspected. At *Pl.* IX, *fig.* 12, is the representation of, apparently, a minute frondescent fossil millepore, from Chippenham.

Favosites.—A stony, simple polypifer, in various forms, composed of parallel, prismatic, fasciculated tubes. The tubes are pentagonal and hexagonal; regular or irregular; contiguous and rarely articulated.

The Favosites resemble the honey-comb in appearance. Lamarck describes two species, both fossil.

Sp. 1. *F. alveolata.*—Turbinated, irregular, transversely sulcated on the outside; the tubules rather large and subhexagonal; the inside of the partitions striated.—*Esp. Supp.* II, *Tab.* IV.

This fossil is particularised as being a turbinated mass, as if truncated at the summit, its upper surface showing the terminations of unequalized pentagons and hexagons, appearing like a net-work. The descriptions agree with the fossil from Dudley, represented *Organic Remains*, Vol. II, *Pl.* VII, *fig.* 3 and 7, and the fossil, *Organic Remains*, Vol. II, *Pl.* V, *fig.* 9, is perhaps referrible to this genus.

2. *F. Gothlandica.*—With solid, parallel, contiguous, and hexahedral prisms. *Amœn. Acad.* I, *Tab.* IV, *fig.* 27.

This fossil is very interesting. It differs from the other species in the prisms being parallel with each other, as is observed by Lamarck, like the prisms of basalt. In the specimen which I possess, the angular tubes are so filled with earthy matter as not to allow the discovery of the state of the septa.

Lamarck has thought it necessary to separate *Tubipora catenulata*, chain coral, from the genus *Tubipora*, and to place it in a distinct genus, *Catenipora*, and to form a genus, *Tubipora*, for the reception of *T. musica* only. But, by this arrangement, eight species, placed by Gmelin under this genus, besides the fossil species *radians* and *ramulosa**, are removed, and no other genus proposed for their reception.

But the chief generic character of these animals, as derived from their ascertained structure, is, that the animal substance contained in each tube so communicates with the whole mass by an intercurrent organization, as to render it one connected system; and, by retaining the original arrangement of the perspicacious Linnæus, with a very small change in his definition, the genus will be found sufficiently distinct and comprehensive; and the several species, the structure of which is known, will be characterised by the different modes of organization by which this communication is effected.

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* Organic Remains, Vol. II, p. 13, *Pl.* I, p. 18, *Pl.* III, *fig.* 1.

Tubipora.—A stony polypifer formed by cylindrical or oval tubes, communicating laterally with each other.

Sp. 1. *T. musica.*—Formed by erect, cylindrical, parallel, and distinct geniculated tubes, containing an internal tubular organization, connected by small radiating tubuli passing through the external tubes and the transverse plates, by which the tubes are supported and united.
Recent.

2. *T. radians.*—With erect parallel tubes, including others, which, by radiating horizontally through the external tubes, connect the whole.—*Org. Rem.* Vol. II, p. 13; *Pl.* I, *frontispiece.*
Fossil.

3. *T. catenulata.*—With erect, oval, parallel tubes, laterally porous, and placed in vertical laminæ, which, by anastomosing, form a chain-work.—*Amœn. Ac. Tab.* IV, *fig.* 20. It is also represented, *Org. Rem. Pl.* III, *fig.* 4, 5, 6.
Fossil.

4. *T. axillaris.*—With very short, distant, erect, cylindrical tubes, placed in the connecting angles of flexuous vertical laminæ.—*Millep. Serpens. Amœn. Ac.* I, *Tab.* IV, *fig.* 26.
Fossil.

5. *T. ramulosa.*—Formed of tubes connected by sub-dichotomous ramifications.—*Org. Rem.* Vol. II, p. 18, *Pl.* III, *fig.* 1.
Fossil.

6. *T. fascicularis.*—*O. Fabr. Fn. Groenl.* 429.
Fossil.

7. *T. ramosa.*—*Koelruter Act. Petrop.* p. 374, *Tab.* X, *fig.* 3.
Recent.

8. *T. pinnata.*—*Pallas el. Zooph.* p. 247, n. 151.
Recent.

9. *T. penicillata.*—*O. Fabr. Fn. Groenl.* p. 429, n. 430.
Recent.

10. *T. flabellaris.*—*O. Fabr. Fn. Groenl.* p. 430, n. 431.
Recent.

11. *T. stellata.*—*Modeer. n. Act. Stockh.* 1788, n. 10, *Tab.* VII, *fig.* 1.
Fossil.

12. *T. strues.*—*Modeer. n. Act. Stockh.* 1788, 4, n. 1.
Fossil. *Org. Rem.* Vol. II, p. 16, *Pl.* II, *fig.* 1.

An interesting fossil is found among the diluvial substances of the Farringdon gravel, which has not hitherto been described, and which appears to belong to this genus.

It is formed of tubes about the size of a crow's quill, inosculating frequently at its base; the cavities of the tubes are divided by very closely-set transverse plates, pierced with a small, well-defined central foramen. Further opportunities of examining the fragments of this fossil are necessary to allow of determining whether there exists any other communication between the tubes besides that resulting from their early inosculations. Until then its specific characters can hardly be considered as ascertained; but, should nothing contradictory be discovered, it may be distinguished as *T. anastomosans.*

This fossil is seldom found in a state which will lead to a suspicion of its nature. The broken tubes, for they are generally in fragments, have mostly a whitish and shelly appearance; but, on their surface being examined with the aid of a lens, it is found somewhat to resemble that of shagreen skin, and to give the notion of its having been covered by the labours of some parasitic animalculæ: but on examining the substance at the fractured ends, it was found exactly to accord with the external surface, being composed of small, crumbly, rather oblong, particles, appearing as if held together by an imperfect adherence. The substance of the *Tubipora musica* being also examined, it was found to be of the same construction.

LAMELLATED POLYPIFERS.

Stony polypifers, with lamellated stars; or with undulating grooves, furnished with lamellæ.

LAMELLATED POLYPIFERS, *with terminal stars.*

Stylina.—A stony polypifer, formed of simple thick masses, echinated in the upper part. Numerous cylindrical fasciculated tubes, containing radiating lamellæ, with a solid axis: the solid styliform axes projecting beyond the tubes.

St. echinulata.—Recent, from the South Seas.

The recent species which Lamarck considers as the type of this genus, and which is the only one with which he is acquainted, was brought from the South Seas by Perron and Le Sueur, and furnishes us with another instance of the astonishing fact of animals whose remains are found in the formations containing the reliques of animals of the earliest creation; no traces of which have been seen in any of the subsequent formation, but which are now found in a living state in the seas of the opposite hemisphere.

Different species of this genus are found in the transition limestone; in one of these, the fossil is simple, of a turbinated or rather of a longish clavated form, terminating at its upper end in a round, lamellated star, with a projecting style-like axis in the centre, *Pl.* X, *fig.* 4. In another species, a similar structure exists, except that instead of the periphery being circular, it is angular, and generally either pentagonal or hexagonal. In a third species, the fossil is of a compound construction, being formed by the union of polygonal, chiefly hexagonal tubes. This fossil has a highly ornamented surface; a projecting sharp ridge surrounds every star; the styloid projecting axis rises from a depression in the centre, and from its sides the surrounding lamellæ ascend with an undulating sweep to the acute surrounding ridge; the whole giving to each star somewhat of a floriform appearance. A small portion of this fossil is represented *Pl.* X.

Not having the opportunity of reference to the specimen referred to by Lamarck, the classification of these fossils must be indeed considered as conjectural: but it must be observed, that they appear to accord with the characters of Stylina; and that there does not appear to be any other genus in which they can be placed.

Sarcinula.—A stony polypifer, formed in a free, simple, thick mass, by tubes united together. The tubes numerous, cylindrical, parallel, and vertical, accumulated in bundles, by intermediate and transverse septæ. Radiating lamellæ within the tubes.

It differs from *tubipora* in its tubes being lamellated, and, from *stylina*, in having no central style.

1. *Sarc. perforata.*
   This species is only known recent.
2. *Sarc. organum.*
   This is described as being found recent in the Red Sea. Fossil specimens are also found on the coast of the Baltic.—*Madrep. Organum. Am. Ac. Tab.* IV, *fig.* 6.

Caryophillia.—A stony fixed polypifer, simple or ramified; the stem and branches rather turbinated, and striated longitudinally, each being terminated by a cell, radiated in a stelliform figure.

These substances are separated by Lamarck from the Madreporæ, in which they were placed by Linnæus, and retained by Solander. Their distinctive character is, that their polypiferous cells are really terminal; the extremity of the stem, or of each branch, being terminated by a single lamellated star.

Under this genus are placed:—

I. Those with simple stems, solitary or fasciculated.

1. _Car. Cyathus. Mad. Cyathus, Sol. and Ellis, Tab._ XXVIII, _fig._ 7; _Organic Remains,_ II, _Pl._ IV, _fig._ 1.
Fossil.
2. —— _Calycularis. Mad. Lin. Esper. Tab._ I, _fig._ 16.
Fossil.
3. —— _truncularis._—Aggregated; with thick cylinders, externally reticulated and connected by a lamellated crust, with radiating stars and a striated edge.
Recent.
4. _Car. fasciculata. Mad. fascicularis.—Lin. Sol. and Ellis, Tab._ XXX.
Well preserved fossil specimens of this coral are found in the transition limestone of Gothland.
Fossil.
5. —— _astreata. Mad. musicalis.—Esper._ I, _Tab._ XXX, _fig._ 1.
6. —— _musicalis. Mad. musicalis.—Lin._
Fossil in the mountain limestone of Ireland.

II. Those with divided stems or ramified.

7. —— _flexuosa. Mad.—Lin. Sol. and Ellis, Tab._ XXXII, _fig._ 1; _Organic Remains,_ II, _Pl._ VI, _fig._ 8.
Fossil in the mountain limestone of the neighbourhood of Bristol.
8. —— _cespitosa. Mad. flexuosa.—Sol. and Ellis, Tab._ XXXI, _fig._ 5, 6.
9. —— _anthophyllum. Mad. anthophyllites.—Sol. and Ellis, Tab._ XXIX.
10. —— _cornigera. Mad. ramea, var.—Esper._ I, _Tab._ X.
11. —— _ramea. Mad.—Lin, Sol. and Ellis, Tab._ XXXVIII.
12. —— _fastigiata. Mad.—Sol. and Ellis, Tab._ XXXIII.
13 —— _angulosa. Mad.—Esper._ I, _Tab._ VIII.
14. —— _sinuosa. Mad. angulosa.—Sol. and Ellis, Tab._ XXXIV.
15. —— _carduus. Mad.—Sol. and Ellis, Tab._ XXXV.

Turbinolia.—A stony polypifer; free, simple, turbinated or cuneiformed; longitudinally striated on the outside; the base pointed, the terminating cell stelliformly lamellated and sometimes oblong.

These bodies are considered, by Lamarck, as differing from *Caryophillia* in not being fixed or adherent.

Lamarck enumerates eight species, all of which are fossil.

1. *Turb. patellata.—Organic Remains*, II, *Pl.* IV, *fig.* 6.
An interesting specimen of this species is formed by a spathose cast retaining satisfactory marks of its origin.
2. —— *turbinata.—Mad. Am. Acad.* I, *Tab.* IV, *fig.* 2, 3, 7, *Organic Rem.* II, *Pl.* IV, *fig.* 3, 10, 11.
3. —— *cyathoides.—Mad. turbinata. Am. Acad.* I, *Tab.* IV, *fig.* 3; *Organic Remains*, II, *Pl.* IV, *fig.* 3.
4. —— *compressa.—Organic Remains*, II, *Pl.* IV, *fig.* 9.
5. —— *crispa.*—Cuneiform, sulcated externally with longitudinal undulated grooves; the star oblong, with rough lamellæ on the side.—*Grignon.*
6. —— *sulcata.*—Cylindrically striated; with longitudinal grooves, the interstices transversely striated.—*Grignon.*
7. —— *Clavus.*—Clavatedly turbinate, straight, with longitudinal granulated and subdentated striæ.—*Agin. and Aix-la-Chapelle.*
8. —— *Caryophyllus.*—Roundish, but turbinated, with simple striæ externally.—*Organic Remains*, *Pl.* XIII, *fig.* 10.

Cyclolites.—A stony free polypifer, orbicular or elliptical; convex and lamellated in the upper part, with a central groove; flat beneath, with sunk, concentric circular lines; one lamellated star occupying the upper surface, with entire, smooth, and very slight lamellæ.

1. *Cycl. numismalis.—Mad. porpita; Lin. Am. Ac.* I, *Tab.* IV, *fig.* 1, *a. b.*
2. —— *hemisphærica.—Scheuch. Herb. Diluv. Tab.* XIII, *fig.* 1.
3. —— *cristata.*—Orbicular; convex and lamellated on the upper side, with variously crested, slightly decussating ridges.
4. —— *elliptica.*—Convex on the upper part; stellated by obsolete lamellæ; with an elongated central groove.—*Guett. Mem.* Vol. III, *Tab.* XXI, *fig.* 17, 18.
Fossil. Perpignan.

Only known as fossils.

Lamarck observes, that this last fossil is the largest of the known species of this genus, and that its oval or elliptical figure is peculiar to it. The fossil here described is the same as is figured, *Org. Rem.* Vol. II, *Pl.* X, *fig.* 1, 2, 3, 4, and its nature enquired into, p. 113.

The superior part of this fossil, possessing the longitudinal groove, derives a smooth downy appearance, from innumerably fine striæ, formed by articulated fibres, which, proceeding from the margin of the inferior surface, pass round every part of the upper surface, and terminate in the sides of the central longitudinal groove. The inferior surface is nearly flat, and is marked by concentric linear ridges and corresponding depressions, intersected by numerous lines, radiating from the centre to the circumference. The examination of this peculiar organization evinces it to be probable that it gave to this animal the power of fixing itself, like the remora or sucking-fish; whilst, by the opening in its superior part, it alternately received and ejected the sea water, the medium of its nourishment.

Supposing the animal laid with its inferior surface, on any substance wet with the sea water, the retraction of the fibres upwards, about the centre of that surface, would produce a cavity and a vacuum between that surface and the surface of the body on which the animal was placed: and there would be obtained such a degree of adhesion, that no removal of it from that spot could take place, whilst the vacuum was preserved. On the other hand, on the contracting of the perpendicular muscular fibres terminating on the edge of the inferior surface, the edge would be raised; air would gain access to the vacuum, and the animal be immediately loosened. But whilst fixed by its inferior surface, the muscular fibres of the upper convex surface would, by their contraction, draw down the whole upper surface, and at the same time widen the central longitudinal opening, and necessarily expel the contents of the ventricular cavity. The immediate subsequent relaxation of these fibres would then occasion the refilling of the cavity; and thus the alternate filling and emptying of the ventricular cavity would be continued. The examination of the figure given by Guettard, Memoires, *Table* XXI, *fig.* 17, 18, confirms this opinion.

The figure given by Scheuchzer, *Herb. Diluv. Tab.* XIII, *fig.* 1, appears to be a correct representation of the second species, *C. hemisphærica.*

Fungia.—A stony, free polypifer, simple, orbicular or oblong; convex and lamellated in the upper part, with an oblong central groove; concave and rough beneath. The star single, lamellated, and subproliferous, occupies the upper part; the lamellæ are dentated or rough on the side.

The extensive surface which almost every species of this genus possesses, formed by a single star, probably the labour of a single animal, shows the propriety of placing it in a distinct genus.

Sp. 1. *F. semilunata.*—Compressed at the sides, striated outwardly; the edge bowed; a longitudinal groove, and a short pedicle. Fossil.
2. — *compressa.* —*Indian Seas.*
3. — *cyclolites.* —*Indian Seas.*
4. — *patellaris.* —*Sol. and Ellis, Tab.* XXVIII, *fig.* 1-4
5. — *agariciformis*—*Sol. and Ellis, Tab.* XXVIII, *fig.* 5, 6.
6. — *scutaria.* . . —*Rumph. Amb.* VI, *Tab.* LXXXVIII, *fig.* 4.
7. — *limacina.* . . —*M. pileus, Sol. and Ellis, Tab.* XLV.
8. —*talpa.* . . . . —*Seba,* III, *Tab.* III, *fig.* VI, *&* *Tab.* CXII, *fig.* 31.
9. — *pileus.* . . . —*Rumph. Amb.* VI, *Tab.* LXXXVIII, *fig.* 3.

Fossils of this genus have been found at Steeple Aston.

Pavonia.—A stony polypifer, fixed and frondescent; the lobes flat, subfoliaceous, erect or ascending, with stelliferous rugæ or grooves on each side.

The stars lamellated, in rows, sessile, and rather imperfect.

None of the species of this genus have been found fossil.

Sp. 1. *Pav. agaricites.* —*Mad. agaricites.*—*Lin. Sol. & Ell. Tab.* LXIII.
2. —— *cristata.* . —*Knorr Delic. Tab.* A. X. *fig.* 1.
3. —— *lactuca.* . —*Sol. and Ellis, Tab.* XLIV.
4. —— *boletiformis.*—*Mad. Cristata. Ellis and Sol. Tab.* XXXI, *fig.* 3, 4.
5. —— *divaricata.* —*Indian Seas.*
6. —— *plicata.* . . —*Esper. Supple.* I, *Tab.* LXVI.
7. —— *obtusangla.* —*Indian Seas.*
8. —— *frondifera.* —*South Sea.*

Agaricia.—A stony polypifer, fixed, with flat, subfoliaceous expansions, the upper surfaces only having stelliferous grooves.

The stars lamellous, sessile, and in rows, most frequently imperfect and hardly distinct.

The Pavoniæ and the Agariciæ agree in some respects; the stars are disposed in grooves or on rugæ in lines which give the first idea of the Meandrinæ.

But in the Pavoniæ, both surfaces of the foliaceous expansion are constantly furnished with stelliferous wrinkles or grooves, whilst in the Agariciæ only one surface is thus furnished; and although, from the folding of the expansions, contradictory appearances may be seen, the correctness of this observation will be ascertained by minute inspection.

Sp. 1. *Ag. cucullata.* —*Mad. Sol. and Ellis, Tab.* XLII.
2. — *undata. . .* —*Mad. Sol. and Ellis, Tab.* XL.
3. — *ampliata. .* — *Mad. Sol. and Ellis, Tab.* XLI, *fig.* 2.
4. — *rugosa. . .* —*South Sea.*
5. — *papillosa. .* —*South Sea.*
6. — *lima. . . . .*—*South Sea.*
7. — *explanulata.*—*Mad. pileus. Esper.* I, *Tab.* VI.

No fossil specimens have been described.

Meandrina.—A stony polypifer, fixed, in a simple hemisphærical or sphæroidal mass.

On the convex surface are excavated, open, winding, ambulacræ, lamellated on each side. The lamellæ are transverse and parallel, adhering on each side of hillock-shaped ridges.

The lamellæ abut upon the hillock-like ridges: and the Ambulacra may be compared to tortuous vallies, separated by corresponding hills: the lamellated ridges occupy the interstices of the tortuous vallies which holds the polypes and thus separates them.

Sp. 1. *Meand. labyrinthica.*—*Mad. labyrinthica, Sol. and Ellis, Tab.* XLVI, *fig.* 3, 4.
2. ——— *cerebriformis.*—*Shaw's Miscel.* IV, *Tab.* CXVIII. *The American Seas. Seba Mus.* III, *Tab.* CXII, *fig.* 5, 6.
3. ——— *dædalea. . .* —*Mad. dædalea, Sol. and Ellis, Tab.* XLVI, *fig.* 1.
4. ——— *pectinata. . .* —*Lin. Sol. and Ellis, Tab.* LXVIII, *fig.* 1.
5. ——— *areolata. . . .*—*Sol. and Ellis, Tab.* XLVII, *fig.* 4, 5.
6. ——— *crispa. . . . .*—*Seb. Mus.* III, *Tab.* CVIII, *fig.* 3-5.
7. ——— *gyrosa. . . .* —*Mad. Sol. and Ellis, Tab.* LI, *fig.* 2.
8. ——— *phrygia. . .* —*Mad. Sol. and Ellis, Tab.* XLVIII, *fig.* 2.
9. ———*filograna. . .* —*Mad. filograna, Gmelin.*

None of these species are mentioned as having been found fossil; they are however found in this state: some fine specimens are in the British Museum. Very beautiful specimens, impregnated with quartz, are in the

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collection presented by Dr. Nugent to the Geological Society, collected by him on the Island of Antigua, with several other siliceous remains of *Astreæ, Madreporæ*, &c.

Hydnophora.—A stony polypifer, fixed and incrusting other bodies; either forming a subglobose, gibbous, or lobated mass, or spread in subfoliaceous lobes; the upper surface is set with little stars raised in pyramids or little mounts.

The stars project and are conical, or like little hillocks; the central axis is solid, simple, or dilated, surrounded by radiating lamellæ adhering to it.

In the Hydnophoræ, as in the Meandrinæ, the raised cones and little hillocks are the parts which occupy the interstices which are left by the polypes between them; the polypes existing in the vallies, where they adhere to each other. In the Hydnophoræ, the cones, as well as the little hillocks, are insulated and circumscribed; whilst the hillocks in the Meandrinæ are not.

The necessity of placing these fossils under a distinct genus was seen by M. Fischer, of Moscow, who distinguished it by the name *Hydnophora*. Lamarck also, seeing the necessity of their separation, formed the genus *Monticularia* for their reception.

Sp. 1. *Hydnoph. folium.* Recent.
2. ———— *lobatum.* Recent.
3. ———— *polygonatum.* Recent.
4. ———— *microconos.*—*Mad. exesa. Pallas Zooph.* p. 290. *Sol. & Ell. Tab.* XLIX, *Hydnophora Pallasii, Fisch.*
5. ———— *meandrinum.*
6. ———— *Cuvieri.* Fossil. *Russia Fisch. Rech. No.* 4, *Tab.* I, *fig.* 2.
7. ———— *Molii.* Fossil. *Russia Fisch. Rech. No.* 5, *Tab.* I, *fig.* 1.
8. ———— *Knorrii.* Fossil. 4 *Fisch. Rech. No.* 6, *Guettard* III, *Pl.* XXVII, *fig.* 2.
9. ———— *Guettardi.* Fossil. *Fisch. Rech. No.* 7, *Guettard* III, *Pl.* LXIV, *fig.* 1, 4, 5.
10. ———— *Bourguetii.* Fossil. *Fisch. Rech. No.* 8, *Guettard* III, *Pl.* XLIV, *fig.* 5, 7, 8.

The figures represented, *Pl.* III, *fig.* 19, 21, 22, & 23; VIII, *fig.* 40; IX, *fig.* 41; X, *fig.* 46, in Bourguet's Traité, belong to this genus.

The fossils represented *Organic Remains*, Vol. II, *Pl.* VI, *fig.* 4, *Pl.* XII, *fig.* 1, 2, 4, 6, 11, 13, are also of this genus.

Echinophora.—A stony polypifer, fixed, flat, expanded in a rounded membrane, free and bearing the form of a leaf, finely striated on both sides. The upper surface is echinulated with small papillæ; is besides supplied with rose-formed, convex, tubercles, considerably echinated, and pierced with one or two holes, each covering a lamellated star.

The stars are scattered, circular, and covered; the lamellæ unequal, rather confused, projecting from the bottom and sides, and partly filling up the cavity.

Sp. 1. *Echinoph. Rosularia.* Recent. Sea of New Holland.

Explanaria.—A stony polypifer, fixed, expanded in a free, foliaceous, undulated, or convoluted and sublobated membrane, with one stelliferous surface.

The stars scattered, sessile, and rather distinct.

Explanariæ differs from the following genus, Astrea, in its never, like the latter, heaping into a globular or hemispherical mass; but its expansions, at every age, preserving their foliaceous form, and allowing their under surface to be seen. The stars are only on the upper face; and are circumscribed, and not plunged in wrinkles or grooves.

Sp. 1. *Expl. infundibulum.*—*Pall. Zooph.* p. 332.
2. —— *mesenterina.* . —*Mad. Cinarescens. Sol. & Ell. No.* 26, *Tab.* XLIII.
3. —— *gemmacea.* . . —*Mad. Scabrosa? Sol. & Ell.* p. 156.
4. —— *aspera.* . . . . —*Mad. aspera. Sol. & Ell. Tab.* XXXIX.
5. —— *ringeus.* . . : . —*American Seas.*
6. —— *cristata.* . . . . —*Mad. Acerosa? Sol. & Ell. No.* 30.

Astrea.—A stony polypifer, fixed, conglomerated, incrusting other bodies, or formed in a subglobose but rarely lobated mass.

The upper surface set with sessile, lamellated, round or subangular stars.

The stars in this genus are circumscribed. The substance is never raised in extended expansions, or developed in leaves, as in the Explanariæ, or ramified like the Madrepores.

The stars are in some separated from each other by interstices, and in others, though circumscribed, they are contiguous.

Stars separate, even from their base.

Sp. 1. *Astr. radiata.* . . . —*Mad. radiata, Sol. & Ell. Tab.*XLVII, *fig.* 8.
2. —— *argus.* . . . . —*Mad. Cavernosa, Esp. Suppl.* 1, *Tab.* XXXVII, *(the great Astroites)*
3. —— *annularis.* . . —*Mad. annularis, Sol. & Ell. Tab.* LIII, *fig.* 1, 2.

4. *Astr. rotulosa*. . . . —*Mad. rotulosa, Sol. & Ell. Tab.* LV, *fig.* 1-3.
5. —— *ananas*. . . . —*Mad. ananas, Sol. & Ell. Tab.* XLVII, *fig.* 6.
6. —— *detrita*. . . . . —*Mad. detrita, Esper. Suppl.* I, *Tab.* XLVI.
7. —— *porcata*. . . . —*Mad. porcata, Esper. Suppl.* I, *Tab.* LXXI.
8. —— *punctifera*. . —*Mad. Indian Seas.*
9. —— *myriopthalmia.—Mad. Indian Seas.*
10. —— *micropthalmia.—Sea of New Holland.*
11. —— *pleiades*. . . . —*Mad. pleiades, Sol. & Ell. Tab.* LIII, *fig.* 7, 8.
12. —— *Stellulata*. . —*Mad. stellulata? Sol. & Ell. Tab.* LIII, *fig.* 3, 4.
13. —— *obliqua*. . . . —*Sea of Guiana.*
14. —— *palifera*. . . . —*South Sea.*
15. —— *pulvinaria*. . —*South Sea.*

Contiguous Stars.

16. *Astr. dipsacea*. . . . —*Mad. favosa, Sol. & Ell. Tab.* L, *fig.* 1.
17. —— *favosa*. . . . . —*Mad. favosa, Esper. Suppl.* I, *Tab.* XLV, *fig.* 1.
18. —— *denticulata*. - - —*Mad. denticulata, Sol. & Ell. Tab.* XLIX, *fig.* 1.
19. —— *versipora*. - - - —*Indian Sea.*
20. —— *deformis*. - - - - —*Indian Sea?*
21. —— *reticularis* - - - —*Mad. favosa. Am. ac. Tab.* IV, *fig.* 16. Frequently found fossil.
22. —— *abdita*. - - - - - —*Mad. abdita. Esper. Supp. Tab.* XLV, *fig.* 2.
23. —— *retiformis*. - - - —Resembles in its network, *Mad. retepora, Sol. & Ell. Tab.* LIV, *fig.* 3-5, which, however, is a true species of *Porites.*
24. —— *heliopora*. - - - —*South Sea.*
25. —— *crispata*. - - - - —*Indian Sea.*
26. —— *diffluens*. - - - - —*South Sea.*
27. —— *calycularis*. - - —*Sea of New Holland.*
28. —— *intersepta*. - - - —*South Sea.*
29. —— *emarciata*. - - - —Fossil; *Grignon.*
    Glomerated; the surface reticulated; the stars subpentagonal, hollow, contiguous; very few lamellæ separate from the axis.
30. —— *siderea*. - - - - - —*Mad. siderea. Sol. & Ell. Tab.* XLIX, *fig.* 2.
31. —— *galaxea*. - - - —*Mad. galaxea, Sol. & Ell. Tab.* XLVII, *fig.* 7.

The corals of this genus will be frequently found in former writers, under the name *Astroites.*

At *Pl.* IX, *fig.* 11, is represented the section of an Astrea in calcedony, from Antigua, by Dr. Nugent.

Porites.—A stony polypifer, fixed; ramified; or lobated and obtuse; the outer surface stellated all over.

The stars are regular, nearly contiguous, superficial or excavated; no margin, or an imperfect one; the lamellæ filamentous, interrupted or cuspidated.

Porites resembles both Astrea and Madrepora in some respects; but their stars differ materially. They are not at all or but partially circumscribed; their lamellæ are but filaments, like the points of pins, and are either tuberculated or cuspidated. The edge of each star is dentated or echinated, so as to be confounded with the interstices which are often echinated in the same manner.

Sp. 1. *Por. reticulata.* . —*Mad. retepora. Sol. & Ell. Tab.* LIV, *fig.* 3-5.
2. —— *conglomerata* —*Absque descriptione, Sol. & Ell. Tab.* XLI, *fig.* 4.
3. —— *astreoides.* - —*American Ocean.*
4. —— *arenacea.* - —*Mad. arenosa? Gmelin.*
5. —— *clavaria.* - - —*Mad. porites. Sol. & Ell. Tab.* XLVII, *fig.* 1.
6. —— *scabra.* - - - —*Mad. digitata. Sol. & Ell. No.* 74.
7. —— *elongata.*
8. —— *furcata.*
9. —— *angulata.* - - —*South Sea.*
10. —— *subdigitata*: - —*South Sea.*
11. —— *cervina.* - - - —*Indian Sea.*
12. —— *verrucosa.* - - —*Mad. spongiosa? Sol. & Ell. No.* 49.
13. —— *tuberculosa.*
14. —— *complanata.*
15. —— *rosacea.* - - - —*var. Mad. foliosæ? Sol. & Ell. Tab.* LII.
16. —— *spumosa.* - - —*Knorr. delic. Tab.* A. I, *fig.* 4.

Pocillopora.—A stony polypifer, plant-formed, ramose or lobated; the surface set with deep cellules, as if scooped out, with porous interstices.

The cells few, distinct, hollowed into pits, the edges rarely prominent; obsoletely stellated; the lamellæ very narrow, sometimes none.

The pocilliform shape of the cells, and the margins having little or no projection, separate this genus from Madrepora; and the depth and fewness of the lamellæ from porites.

Sp. 1. *Pocill. acuta.* - - - —*Mad. damicornis. Sol. & Ell. No.* 73.
2. ——— *damicornis* - —*Mad. damicornis. Pall. Zooph. p.* 334, *Var.* A, B.
3. ——— *verrucosa.* - —*Mad. verrucosa, Sol. & Ell. No.* 78.
4. ——— *brevicornis.* - —*Indian Ocean.*
5. ——— *fenestrata.* - —*South Sea.*
6. ——— *stigmataria.* —*Mad. muricala? Esp. Suppl.* 1, *Tab.* LIV, A, *fig.* 1.
7. ——— *cærulea.* - - —*Mad. cærulea. Sol. & Ell. Tab.* XII, *fig.* 4.

Madrepora.—A stony polypifer, fixed, subdendroidal, ramified; the surface furnished on every part with projecting, muricated cells; the interstices porous.

The cells scattered, distinct, cylindrical, tubular, and prominent; hardly any stellæ; the lamellæ of the internal parietes very narrow.

Linnæus and Pallas, it is noticed by Lamarck, gave the name of Madrepores to all the lamellated polypifers;

in consequence of which, bodies essentially different have been classed together. Lamarck having separated all those lamellated polypifers which appeared to bear distinctive generic characters, retained under the genus Madrepore those only which are not found in form of incrustation, and whose substance is divided in plant-like lobes or branches, with a surface muricated by the sharp projections from stelliform, oblique, subcylindrical, tubular, and slightly laminated cells, and by the finely porous and echinulated interstices.

Sp. 1. *Mad. palmata.* - - - —*Mad. muricata. Esper. Suppl.* 1, *Tab.* LI, LXXXIII.
2. —— *flabellum.* - - - —*American Seas?*
3. —— *corymbosa.* - - —*Rumph. Amb.* 6, *Tab.* LXXXVI, *fig.* 2.
4. —— *plantaginea.* - —*Mad. muricata, Esp. Suppl.* 1, *Tab.* LIV.
5. —— *pocillifera.* - - —*Indian or South Seas.*
6. —— *laxa* - - - - - —*South Seas.*
7. —— *abrotanoides.* - —*Mad. muricata. Sol. & Ell. Tab.* LVII.
8. —— *cervicornis.* - - —*Seba. mus.* 3, *Tab.* CXIV, *fig.* 1.
9. —— *prolifera.* - - - —*Esp. Suppl.* 1, *Tab.* L.

Seriatopora.—A stony fixed polypifer, with thin and rather cylindrical branches.

The cells perforated, slightly lamellated, or ciliated in their edges, and placed in rows, transversely or longitudinally.

This separation from Madrepores is founded on the cells thus placed in rows, having only their margins set with very small plates, or rather hair-like points, instead of plates projecting inwards.

Sp. 1. *Ser. Subulata.*—*Mad. seriata. Sol. & Ell. Tab.* XXXI, *fig.* 1, 2.
2. —— *annulata.*—*South Sea.*
3. —— *nuda.*

Oculina.—A stony polypifer, most frequently fixed; ramose and dendroidal; the branches smooth, spread, and for the most part very short.

The stars, some terminal, the others lateral and superficial.

Although ramified and dendroidal, like the Madrepores, the Oculinæ are distinguishable by their substance being solid, smooth, hardly at all porous, and their stars not numerous,

Sp. 1. *Oc. virginea.* - - - - —*Mad. virginea. Sol. & Ell. Tab.* XXXVI.
2. —— *hirtella.* - - - - —*Mad. hirtella. Sol. & Ell. Tab.* XXXVII.
3. —— *diffusa.* - - - - —*American Sea.*
4. —— *axillaris.* - - - - —*Sol. & Ell. Tab.* XIII, *fig.* 5.
5. —— *prolifera.* - - - - —*Sol. & Ell. Tab.* XXXII, *fig.* 2
6. —— *echidnea.* - - - - —*Mad. rosea. Esp.* 1, *Tab.* XV.
7. —— *infundibulifera.*
8. —— *flabelliformis.* - - —*Seba Mus.* 3, *Tab.* CX, *fig.* 10.
9. —— *rosea.* - - - - - - —*American Ocean.*

CORTICIFEROUS POLYPIFERS.

Phytoidal or dendroidal, composed of two sorts of distinct parts; one a solid, central axis, and the other a fleshy incrustment, which covers it, and contains the polypes.

The axis is full, inorganic, either horny, or in part or entirely stony.

The polypiferous incrustment constitutes, after its removal from the water, a corticiform celluliferous envelope, more or less friable.

Corallium.—A fixed polypifer, dendroidal, not articulated, rigid and corticiferous.

The axis caulescent, ramose, stony, solid, and striated on the surface.

The cortical part, whilst living, is soft, fleshy and polypiferous; after drying it is hardened and porous, with octovalved cells.

The propriety of allotting to this substance a distinct genus must be evident; it is not articulated, therefore is not an Isis, with which Linnæus had blended it; and its stony axis will not permit its being placed among the Gorgonia, as proposed by Solander.

Sp. 1 *Cor. rubrum. Isis nobilis,* Lin. — *Gorgonia nobilis,* Sol. and Ellis, *Table* XIII.

This substance is very rarely discovered fossil; but Scilla states that he found it in the neighbouring hills of Messina, in a mineralised state, reduced to lime, mixed with echini, shells, &c. in a similar state. He found the coral in beautiful branches as well as in fragments; the whole surface deprived of its colour; although, in some of the thicker fragments, a purplish hue might still be found in the internal parts*.

Silicified fragments of this substance are sometimes found among the Blackdown fossils, showing, by their transparency, the beautiful red colour remaining in the internal part.

Melitæa.—A fixed dendroidal polypifer, composed of an articulated, nodose axis, and of a permanent corticiform incrustation.

The central axis is caulescent, ramose, formed of stony substriated portions joined by rather spongy and tumid articulations.

The cortical crust, in a living state, is fleshy and polypiferous; when dry, it is thin and cellular.

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* De Corporibus marinis lapidescentibus, &c. Angustino Scilla, Romæ, p. 55, *Tab.* XX, *fig.* 1.

The Meliteas differ from the Isides, the following genus, in the character of their articulations, the joints in the former, though stony, being spongy and tumid; but in the latter, horny and contracted.

Sp. 1. *Mel. ochracea.* . —*Isis ochracea. Lin. Soland.*
2. —— *retifera.* . —*Isis aurantia. Esp. Suppl.* II, *Tab.* IX.
3. —— *textiformis.*—*South Seas.*
4. —— *coccinea.* . —*Isis coccinea. Sol. and Ellis, Tab.* XII, *fig.* 5,

This genus has not been described as a fossil; but the writer is of opinion that a fossil specimen of one of its species is in his possession.

Isis.—A fixed dendroidal polypifer, composed of a jointed axis and a corticiform crust, not adherent.

The axis central, caulescent, and ramose, formed of stony striated portions, connected by a contracted horny substance.

The cortical part, in a living state, is fleshy and polypiferous; but separates entirely or partly from the stem, on being removed from the water.

Sp. 1. *Isis hippuris.* . —*Sol. and Ellis, Tab.* III, *fig.* 1-5
2. —— *elongata.* —*Esper.* I, *Tab.* VI.
3. —— *dichotoma.*—*Esper.* I, *Tab.* V.
4. —— *encrinula.* —*Seas of New Holland.*
5. —— *coralloides.*—*South Seas.*

It was the disjointed members of some species of this genus which were found by Scilla in the mountains of Sicily, and which he at first believed to be the *tibiæ* of some animal; but on referring to Imperatus (*Hist. Nat. lib.* 27), he was soon convinced of his mistake, and enabled to trace them to their real origin*.

Antipathes.—A fixed, subdendroidal polypifer, composed of a central axis, and a corticiform, fugacious and deciduous crust.

The axis is flattened and fixed at its base, caulescent, sub-ramose, horny, solid, flexible, rather fragile, and mostly set with small spines.

The cortical crust is gelatinous and polypiferous, covering the living axis and branches, and falling off on the removal of the specimen from the water.

Antipathes spiralis, Sol. and Ellis, Tab. XIX, *fig.* 1-6; *Pall. Zooph.* p. 217; *Esper.* 2, *Tab.* VIII, may be referred to as the type of the genus of which seventeen species have been particularised.

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* De Corporibus marinis lapidescentibus, *Tab.* XIX. Organic Remains, &c. Vol. II, p. 72, *Pl.* VIII, *fig.* 2, 4, 7, 9.

Gorgonia.—A fixed dendroidal polypifer, composed of a central axis and a corticiform crust.

The axis flattened and fixed at the base, caulescent, ramose, substriated, solid, horny, and flexible.

The cortical crust covering the axis and branches, in the living state, is soft, fleshy and polypiferous; in the dry state spongy, porous, and friable; the surface pierced with the superficial or the projecting openings of cells.

Gorgonia reticulata, Sol. and Ellis, Tab. XVII, will serve as an example of this genus, forty-eight species of which have been observed.

No specimen of either of these genera appears to have been noticed in a mineralised state, a circumstance which, at first consideration, appears difficult of explanation, since the axis seems, in general, to be sufficiently solid to authorise the belief, that it might remain long enough in a subterraneous or subaqueous situation to admit of its impregnation with earthy particles, previous to its becoming entirely decomposed. But on farther consideration of the original nature of the substance, which does not owe its solidity to the intermixture of earthy particles, but merely to the condensation of a horny or membranaceous substance, its decomposition, under the circumstances mentioned, should rather be expected than its preservation.

Corallina.—The fixed, phytoidal, ramified polypifers ranging under this genus, have not, as far as have come to our knowledge, been discovered in a mineralised state: a circumstance which may perhaps be sufficiently accounted for, by their extreme delicacy, and by the frequent separations or articulations into which their substance is divided. By these circumstances their adherence together sufficiently long after death to allow of impregnation would be prevented; although the dense calcareous crust investing their filiform axis might appear to be well adapted to admit it.

The delicacy of structure and the prevalency of corneous membrane in the substance of *Penicillus* and *Flabellaria* seem also to be sufficient to account for neither of these bodies having been found fossil. From similar considerations the remains of the tubuliferous polypi can hardly be expected to be discovered in a mineralised state.

Encrini and *Pentacrini.*—Our attention is now claimed by a series of animals rendered interesting, not only by their curious forms and extraordinary structure, but also by their being among the earliest inhabitants of this planet. Hence they are so far aliens of this world, that whilst immense tracts of rocks are literally formed of the entombed remains of different species in a mineralised state, only five or six fragments of the remains of one of these numerous species have yet been discovered in a recent state.

The general characters which embrace the different genera and species of these animals are,—an acephalous animal, attached by a radiciform, subarticulated base, from which arise cylindrical, oval, or pentagonal vertebræ possessing pentaphylloidal or stelliform articulating surfaces and central openings, and forming an articulated tubular spine, supporting a pelvis from which proceed articulated arms, hands, fingers, and tentaculæ, forming a body which bears a floriform appearance.

These animals appear to have had a considerable range for the seizure of their prey, without possessing absolute locomotion; the peculiar mode of the articulation of their vertebræ affording them a great degree of mobility, with considerable security against dislocation. They have been hitherto classed under two genera; one, the *Echinus,* with chiefly cylindrical vertebræ; the other, the *Pentacrinus,* with principally pentagonal vertebræ.

The Encrinus has been divided into species, which have been hitherto distinguished chiefly by, and named according to, the characters of the base of the floriform part of the animal, with which the uppermost vertebra is articulated.

Sp. 1. The *Lily Encrinus,* Organic Remains, Vol. II, *Pl.* XIV, has this part formed of five wedge-shaped bones, *ossa innominata,* which constitute the smooth circular central part, round which are disposed five trapezoidal pieces, *ribs.* On the upper edge of each of these is placed an ossicle termed a *scapula,* and on the two superior oblique surfaces of this little bone are disposed the first ossicles of two arms, each of which divide into articulated fingers and tentaculæ, which when closed bear a lily-like appearance, and when opened and expanded form a nearly circular net of jointed meshes. These, on closing, would secure the prey and direct it into the stomach, which was in all probability placed in the central cavity formed by the pentagonal base and its superincumbent ossicles.

The pentagonal base of this animal is represented at *Pl.* IX, *fig.* 1; the surface of one of the cylindrical vertebræ termed a *trochite* at *Pl.* IX, *fig.* 4; and three of these conjoined at *Pl.* IX, *fig.* 6: when thus united they form a body which is named an *Entrochite.*.

No remains of this species have been found in this island; but in Lower Saxony, Westphalia, and particularly in Brunswick, they are very abundant: the remains of the upper part of the animal are sometimes, though rarely, found in their connected floriform state: their matrix appears to be a limestone of the lias formation.

Sp. 2. The *Cap Encrinite.*—Differs from the preceding in being of a more globose form in its lower part; the base, *Pl.* IX, *fig.* 3, partakes of the same roundness, and is more simple and plain in its construction than that of the preceding species; its arms also differ in being unequally and dissimilarly divided.—*Organic Remains*, Vol. II, *Pl.* XV, *fig.* 9.

The fossil vertebral remains of this animal literally constitute the rocks, considered as mountain limestone, which traverse part of Yorkshire, Lancashire, Westmoreland and Derbyshire; the remains thus preserved forming a most useful and ornamental marble. But extraordinary as it may appear, although these remains exist to so immense an extent, only one body, with the arms, &c. of the animal, has been yet stated to have been found; and this was so far imbedded in its matrix, as to restrict our knowledge of the structure of the animal to the particulars abovementioned.—*Organic Remains*, Vol. II, *Pl.* XV, *fig.* 9.

Sp. 3. The *Turban Encrinite.*—The existence of this species was only made known by the preservation of its pentagonal base with some indistinct fragments, in a specimen of limestone, of the earliest formation, from Wenlock edge: the superior elegance of the form of the pentagonal base, *Pl.* IX, *fig.* 7, decidedly marked this animal to be of a different species from the preceding.

The radical termination or organ of attachment of this animal, *Organic Remains*, Vol. II, *Pl.* XV, *fig.* 5, manifests a very curious structure: it terminates in very frequent ramifications, which are jointed by numerous crenulated articulations, admitting a certain degree of mobility.

The limestone in which the remains of this animal are found also contains the remains of madrepores and tubipores, particularly of the chain-coral: the antiquity of its deposition is manifested by its being repeatedly seen alternating with sandstone, above the coal.

Sp. 4. The *Pear Encrinite* (*Organic Remains*, Vol. II, *Pl.* XVI). The radical termination or organ of attachment of this species is of a flat and extended form, and possesses a purplish hue. It has the appearance of having been covered by several coats of a ligamentous or cartilaginous substance possessing crenulated articulations: from this proceed the vertebræ, which are very thin and finely crenulated, and at their lower termination participate with their base in a portion of membranous or cartilaginous matter, which is extended over them. As they approach their superior termination they enlarge rather suddenly, both in width and thickness, receding so far from each other internally as to leave vacuities between them about their centre, which is also pierced by a large foramen. On the uppermost of these vertebræ is placed a flattish body divided into five compartments, answering to the five separated clavicles of the lily encrinite; and on this, the ossicles corresponding to the scapulæ, arms, &c. are disposed in such order, as to form a pear-shaped body, containing in its centre a ventricular cavity, and set round at its upper part with twenty depressions, from which proceeded the fingers of the animal.

With respect to the geognostic situation of these remains, we obtain the following information from Mr. Townshend, who considers it as a fossil of the great Oolite. "Among the extraneous fossils, imbedded in the white clay, (on the surface of the uppermost bed, but not in the body of the rock,) the most interesting are the Encrinites first noticed by the Rev. Benjamin Richardson, at Burfield, Wiltshire, near the summit of the hill on the southern hanging of which Bradford stands; they were next discovered south of the river, on the surface of the rock, in the same bed of white clay, but more than one hundred feet lower than Burfield, and a little elevated above the level of the river: finally, they were traced on the high summit of the opposite hill, yet always deposited in their proper bed*."

Remains of this animal, agatised, have been found at Soissons; its remains are also found at Pfeffingen in Germany, it appearing that the remains found there belonged to much larger animals than those from which the Wiltshire fossils proceeded.

Sp. 5. The *Nave Ecrinite.*—This appellation was employed as a temporary designation of this fossil, derived from its form, it being thought to resemble the nave of a wheel, to which five spokes were attached. This fossil was first noticed by that industrious naturalist, Martin Lister, who describes it as being about the size of a wallnut, but hollow, and rounded into five double points, in the figure of crescents, and having on its bottom the impression of a trochites, or a trochites itself yet adhering: the surface he describes as being formed of rough polygonal plates†. Several specimens of these fossils are represented, *Organic Remains,* Vol. II, *Pl.* XVII, since which Mr. Cumberland has favoured us with the figures of several others of very curious structure, in a very interesting communication, in the fifth volume of the Geological Transactions.

Among the benefits resulting from the researches of the fossilist, is that of being sometimes able to trace, by the contained fossils, beds of marl and clay to the rocks from the decomposition of which they have proceeded. Thus several of the specimens discovered by Lister were described as having been found in the soft earth in the villages of Braughton and Stock in Craven, whilst their subsequent discovery in the mountain-lime of Mendip, and in that neighbourhood, manifests the original bed into which they had passed. Thus, the *pear encrinite* may be found rather to belong to the magnesian limestone rocks than to the white clay, as it is termed, which may have proceeded from the decomposition of those rocks. Dr. Capeller, in a letter to Scheuchzer, describes and figures some of these fossils, with the fingers attached, from the magnesian limestone of the island of Gothland.

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* The Character of Moses established, &c. p. 268.

† Philosophical Transactions, Vol. X.

Sp. 5. The *Plumose Encrinite.*—This fossil is distinguished by its long fingers, partly naked and partly furnished with articulated tentacula, disposed like the feathery appendages on the sides of a quill. This fossil was described in *Organic Remains*, Vol. II, p. 224, from a specimen from Dudley in the possession of Mr. Donovan: I have since seen a specimen, apparently, of this species, in the possession of Geo. Hawker, Esq. of Stroud, in Gloucestershire.

In Volume LII of the Philosophical Transactions, is figured the representation of the body of an *encrinite* or *pentacrinite* found at Pyrton Passage, Gloucestershire, bearing, when closed up, the form of a fig; a similar specimen has been since found also, on the banks of the Severn, by Mr. G. Hawker.

Sp. 6. The *Tortoise Encrinite* (*Organic Remains*, Vol. II, *Pl.* XIII, *fig.* 24) is formed of various angulated plates, disposed in a purse-like form; five of which are pentagonal and surround the mouth, having in the upper edge of each a semicircular notch, from which proceeded a jointed arm dividing subdichotomously: under these is a row of hexagonal plates, and beneath these pentagonal ones, every plate being striated from the centre to the margin, and united by fine crenulations with the adjoining ones.

Various small substances are found, chiefly in the chalk, possessing the characters of this tribe of animals, and of which no recent prototypes are known; such are,

1. the *straight encrinite, Pl.* IX, *fig*. 5, possessing an organ of attachment, with vertebræ, pelvis, and ramifying superior extremity; 2. the *bottle encrinite,* possessing a utricular form, but divisible in its upper portion into parts corresponding with the clavicles, scapulæ, &c. of the lily encrinite, *Pl.* IX, *fig*. 13; 3. the *stags-horn encrinite, Pl.* IX, *fig*. 14, in which the arms, &c. proceed directly in a ramose form, from the trunk of the animal; 4. the *clove encrinite,* (*caryophillus lapideus* of Lhwydd, and other oryctologists) *Pl.* IX, *fig*. 15; 5. the *digitated encrinite,* distinguished by the extraordinary manner in which its spines or arms are connected by numerous digitated processes; the *oval-spined encrinite,* and many others whose forms and characters seem to mark them as closely allied to, if not actually belonging to this family.

The *Pentacrinus* was an animal with a pentagonal, articulated, vertebral column, from the superior part of which, from five bases, proceeded as many articulated arms, speedily dividing into ramifications, closely beset with jointed fingers, bearing much of a plumose appearance.

The form and structure of the fossil remains of the different species of this genus plainly show that the animal possessed similar powers of seizing the surrounding objects of its prey, as the encrinus, but on a wider range.

The fossil vertebræ of this genus are small, flat, and generally pentagonal, stelliform stones, ornamented on both their upper and under surfaces with five petal-formed figures, from the supposed resemblance of which to five lilies the name of the genus, *pentacrinus,* has been derived: these form, by their union, *asteriæ columnares,* or columnar star-stones, being parts of the pentagonal spine; in the figure of which, as well as in the forms of the markings of the vertebræ, considerable differences occur in different species.

On the upper extremity of the spine are disposed the parts which form a pelvis, being in all probability the ventricular cavity, and those parts also which give support to the limbs. As the use of these parts is more obvious in this genus than in that of the encrinus, an excuse will be more readily admitted for adopting for them those terms which are applied to the supposed corresponding parts in the more perfect animals.

On each of the five sides of the upper end of the spine, *Pl.* IX, *fig.* 16, three pieces are disposed, the largest of which *(a)* performs the office of scapula, its upper cotyloidal surface receiving the first bone of the arm *(c)*: on this is placed the second bone *(d)*, the upper part of which is divided into two obliquely disposed surfaces, on which the two first bones *(e)* of a new series, as of the forearm, are articulated, and which first dividing subdichotomously afterwards give out innumerable articulated fingers. Firmness appears to have been given to this arrangement, by the interposition of a small body, *b*, between each scapula, which appears to perform the office of a clavicle by retaining the scapulæ in connection with the trunk. At various distances, in different species, jointed vertebral processes are given out from the spine, apparently for the purpose of aiding the fingers in seizing and retaining the hold of different substances. As there is reason for believing that the jointed spine was of considerable length, and as the fingers were evidently capable of being fully expanded, the range of the animal, though fixed at one extremity, must have been very extensive.

There are undoubtedly several species of this genus; but from the smallness of connected specimens, and from their being often rendered indistinct by their being imbedded, and from other circumstances, the necessary distinction and separation are but seldom capable of being made. The fossils of this genus, however, which are found in Dorsetshire, manifest characters sufficiently important and determinate to be assumed for specific distinction: it is to this fossil I presumed to give the name *briarean pentacrinite,* remarking that it was characterised by its numerous and widely comprehensive arms, &c. and by its long jointed arm-like spinous processes given off from every side of each vertebra.

The fossil remains of this species are particularly abundant in the Cliffs of Lyme and of Charmouth in Dorsetshire. The remains of other species distinguishable from this by the vertebral processes being given off, not from every vertebra, but at certain distances, are found in the lias in different parts of Gloucestershire, and in the more north-eastern parts of the Island; but the discovery of more perfect specimens than those which are at present known will be necessary to be obtained, before the particular characters of the species can be ascertained: more also is required to be known respecting the fossil of M. Hiemer, spoken of in p. 256 of the second volume of Organic Remains, before it can be considered as being of a distinct species.

Whilst this part of the present work was in the hands of the printer, I had the gratification of receiving Mr. Miller's Natural History of the Crinoidea or Lily-shaped Animals: the pleasure which I experienced in contemplating the scientific and successful enquiries of this gentleman, in subjects on which, as a student, I had myself toiled, led me to hope that, by pointing out the importance and extent of his discoveries, I should diffuse pleasure among my readers, and, by giving them a glimpse of the treat there prepared for them, render them eager to partake of a banquet so rich and so cheap, it containing fifty illustrative lithographic plates.

In this work the numerous and interesting animals of former worlds, which have been loosely ranged as Encrinites and Pentacrinites, are classed as the members of one distinct and peculiar family, distinguished as —CRINOIDEA or Lily-shaped Animals. The members of this family are placed under four principal divisions, comprising nine genera, each containing several species, with most of which we had hitherto been but imperfectly acquainted, and of some entirely ignorant.

I. ARTICULATA, in which joints forming the superior cup-like body of the animal articulate to each other, are divided into three genera:—I. *Apiocrinites*, the pear-like lily-shaped animals, dividing into two species, 1. *Ap. rotundus*, and, 2. *Ap. ellipticus*. II. *Encrinites*, the true lily-shaped animal, of which Mr. Miller knows but of one species, 1. *Enc. moniliformis*. III. *Pentacrinites*, five angled lily-shaped animals, comprising five species, 1. *Pent. caput medusæ*. 2. *Pent. briaræus*. 3. *Pent. subangularis*. 4. *Pent. basaltiformis*. 5. *Pent. tuberculatus*.

II. SEMIARTICULATA, in which the plate-like joints, which form the cup containing the viscera, articulate imperfectly with each other, furnish but one genus, I. *Poteriocrinites*, a vase-like lily-shaped animal, one species of which only, 1. *Pot. crassus*, will serve as the type of the generic character; the other species, 2. *tenuis*, having its plates adhere only by sutures and not by articulations, may be considered as forming the transition to the next division.

III. INARTICULATA, in which the plates adhere by sutures, lined by muscular integument. These are divided into, I. *Platycrinites*, broad-plated, lily-shaped animals, in which five broad plate-like scapulæ proceed from a saucer-shaped pelvis, formed of three unequal pieces. The species are, 1. *lævis*; 2. *rugosus*; 3. *tuberculatus*; 4. *granulatus*; 5. *striatus*; 6. *pentangularis*.

II. *Cyathocrinites*, cup-like, lily-shaped animals, with a saucer-shaped pelvis of five pieces, on which are placed, in successive series, five costal plates, five scapulæ, and an intervening plate; from each scapula proceeds one arm having two hands. *Sp.* 1. *planus*, 2. *tuberculatus*, 3. *rugosus*, 4. *quinquangularis*. III. *Actynocrinites*, radiated, lily-shaped animals; the pelvis formed of three plates, on which five first costals and one irregular costal adhere; succeeded by second costals and intercostals, and the scapulæ, from whence five arms proceed, each forming two hands, with several tentaculated fingers. *Sp.* 1. *Triaconta dactylus;* 2. *polydactylus;* 3. *lævis*. IV. *Rhodocrinites*, rose-like, lily-shaped animals, pelvis formed of three pieces supporting five square plates, in the spaces of whose lateral bevelled angles are inserted five heptagonal first costals: from the scapulæ proceeds an arm supporting two hands. There is only one species, 1. *R. verus*.

IV. COADUNATA; the joints of the pelvis anchylosing to the first columnar joint. I. *Eugeniacrinites*, a clove-like, lily-shaped animal, of which but one species is known, 1. *E. quinquangularis*.

Fossil pentagonal plates are frequently found in chalk, which are sometimes connected, and form a body of a marsupial form: considering these remains as belonging to an animal of the family of the encrinites, I introduced them in Organic Remains, Volume II, *Table* XIII, *fig*. 24, as portions of the tortoise encrinite, deriving its name from its plates. Since which, Mr. Mantell, of Lewes, has investigated the remains of this animal with so much care, as to have ascertained it to have been an unattached animal, and without a column: from its purse-like form Mr. Mantell has denominated the fossil *Marsupites*. An interesting account of this fossil may be hoped in the work of Mr. Mantell on the South Down fossils; a work, which, considering the ingenious author's abilities and advantageous situation for the pursuit of these enquiries, may be expected to yield considerable gratification.

The observations of Mr. Miller, on the geological distribution of the Crinoidea, are highly interesting; and I am pleased with the opportunity of pointing out to the student the localities of the different species from Mr. Miller's work; and to add, that the localities of the specimens which I possess, serve to confirm these important observations, and to encourage the opinion that the different genera and species of this family have commenced and terminated their existence at different periods.

Cyathocrinites rugosus is found amongst the earliest traces of organic remains, imbedded in the TRANSITION LIMESTONE formation, in Shropshire, Herefordshire, the Islands of Oeland and Gothland, and in Dalecarlia. *C. quinquangularis* occurs in the magnesian variety of the MOUNTAIN LIMESTONE, at Clevedon; and in MOUNTAIN LIMESTONE, at the Black Rock, near the Avon.

Poteriocrinites crassus is found in the MAGNESIAN BEDS OF MOUNTAIN LIMESTONE, Clevedon; and in MOUNTAIN LIME, at Bristol; and *P. tenuis,* in the MOUNTAIN LIME of Mendip and of Bristol.

Platycrinites lævis occurs in the MOUNTAIN LIMESTONE of Mendip, and in the BLACK ROCK, near Bristol, Dublin and Cork. *P. rugosus,* in MOUNTAIN LIMESTONE of Mendip and Caldy Island. *P. tuberculatus,* in MOUNTAIN LIME strata. *P. striatus,* MOUNTAIN LIMESTONE, near Bristol. *P. pentangularis,* MOUNTAIN LIMESTONE, Bristol, Mendip, and Mitchel Dean; and in the TRANSITION LIMESTONE, Dudley and Dinewaur park.

Cyathocrinites planus, in MOUNTAIN LIMESTONE, Clevedon, and Black Rock, Bristol.

C. tuberculatus, in MOUNTAIN LIMESTONE, Dudley? *C. rugosus*, in TRANSITION LIMESTONE, Shropshire, Herefordshire. the Islands of Oeland and Gothland, and in Dalecarlia*. *C. quinquangularis*, in MAGNESIAN LIMESTONE, Clevedon, and MOUNTAIN LIMESTONE, Black Rock.

Actinocrites triaconta dactylos, in MOUNTAIN LIMESTONE, in Craven in Yorkshire, the Mendip-hills, and Black Rock, Bristol. *A. polydactylus*, in MOUNTAIN LIMESTONE of the Mendip-hills and Caldy Island. *A. lævis* in MOUNTAIN LIMESTONE of Mitchel Dean.

Rhodocrinites. R. verus, TRANSITION LIMESTONE, Dudley, MOUNTAIN LIMESTONE near Bristol, Mendip-hills, and Mitchel Dean.

It appears that all the preceding remains occur in the transition, the mountain and the magnesian limestone deposits, "where," as Mr. Miller observes, "they are lost, (as far, he says, as I have been able to ascertain) and make room for the different species of *Pentacrinites*, which may be traced through the beds of the lias, oolite, and chalk: and of which one species, the *pentacrinus caput medusæ*, has continued from the formation of the lias to our times, and is now met with, though very rarely, in a recent state."

The *Apiocrinites rotundus* is only found adhering to a bed of the oolite formation, and the *Apiocrinites ellipticus* in chalk.

The *radiated Echinodermata.*—The first section of animals under this division contains the *Stelleridæ*, distinguished by their possessing a coriaceous skin, not irritable, but moveable in several points; the body depressed, wider than long, with radiating marginal angles or lobes, more or less numerous and moveable. They are furnished with spines, which are fixed on moveable tubercles; and in some of the genera of this section there exists on the back, opposite to the mouth, a short tubercle, or a reticulated disk; but it has not yet been ascertained what office this part performs. The mouth of these animals is surrounded by five little ossicles or granular substances.

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* It was the body of this animal which I saw in Mr. John Hawker's Collection, and which, from its general form, and the figure of its plates, I considered as belonging to the tortoise encrinite, or the marsupite of Mr. Mantell.

This family is divided, by Lamarck, into four genera: —1. *Comatula;* 2. *Euryale;* 3. *Ophiura;* 4. *Asteria.*

Comatula.—An orbicular, depressed, radiated body, having two sorts of rays, dorsal and marginal, all supplied with calcareous joints. The dorsal rays are very simple, small, cirrous, and filiform, disposed like a coronet on the back of the disk. The marginal rays are always pinnated, and much larger than the simple rays; their inferior pinnulæ are elongated, flattened beneath, and surround the ventral surface. The mouth is beneath, central, isolated, membranous, tubular, and projecting.

The dorsal rays of this animal, by which it clings to other substances whilst seeking for or retaining its prey by its pinnated rays, with its membranous projecting mouth in the form of a purse, are characters sufficiently distinctive of this genus.

Some of the species of this genus are described among the *Stellæ* of Linck, as in *Tab.* XXII, *fig.* 34. *Asteria multiradiata,* Lin.? *Stella rosacea,* Linck, *Tab.* XXXVII, *fig.* 66, &c.

Euryale.—An orbicular, depressed body, with a naked back; divided at its circumference in a row of long, thin, dichotomous, frequently divided, cirrous rays; these rays being flat beneath, and cylindrical on the back. Ten long openings exist in the under part and towards the margin of the disk. The mouth is beneath, and central. The stomach fills, and, of course, possesses the form of the central semiglobular ventricular cavity.

The very fine capillary terminations of the almost innumerable rays of the animals of this genus, and the oblong openings in the lower surface of the disk, two between each ray, serving for the passage of retractile organs, are characters strongly distinctive of this genus.

This genus is distinguished, by Linck, by the name *Astrophyton*, and was designated, by Gmelin, as *Asterias euryale et Asterias caput Medusæ*. The species to which this name applies is the only one which was known to Linnæus.

Ophiura.—An orbicular, depressed body, with the back naked; having, at its circumference, a row of long, thin, simple, cirrous rays; papillous or spinous, and nearly pinnated on their sides; the spines being jointed only at their base. The lower surface of the rays flat, and without any groove or channel; the mouth beneath, and central, with several openings round it: the stomach possesses a subglobose form.

Several species of this genus are described and figured, by Linck, as *Stella longicauda*, *S. lacertosa*, &c., and others are to be found among the *Asteriæ* of Linnæus, as *Asterias aculeata*, &c.

Asterias.—A suborbicular, depressed body, divided at its circumference into angles, lobes, or rays, disposed in a stelliform figure. The lower surface of these lobes, or rays, is furnished with a longitudinal groove, bordered on each side with moveable spines, and with holes for the passage of tubular and retractile feet. The mouth is beneath, and central, and placed in the point where the grooves unite.

The mouth, in these animals, opens directly into the stomach, which has no other opening. It is, in fact, a *cul-de-sac*, augmented laterally by ten elongated and pinnated cæcums, two in each ray, which proceed from the sides of the stomach through three-fourths of the length of the ray.

These are the animals commonly known by the names of star-fish, *Stellæ & marinæ*, &c.

Lamarck has had recourse to an arrangement of these bodies, which is better adapted to facilitate their distinction and examination than any which has been hitherto employed. He divides them into the scutellated and the radiated *Asteriæ:* under the former of which he places those with continuous margins, such as *Pentetagonaster regularis, Pentaceros plicatus & concavus,* &c., of Linck; and, under the latter, the numerous stelliform species.

The fossil remains of the *Stelleridæ* are not frequently found; circumstances proceeding, in a great measure, from the proneness to decomposition of the membranaceous connecting matter.

Fossil remains, referrible to the genera *Comatula,* or *Euryale,* have been supposed to have been found by Rosinus and by Lhwydd; but there is sufficient reason for supposing, that the remains which they described belonged to some species of *Pentacrinites,* of which we have yet to speak. Two fossil specimens, apparently referrible to this genus, are figured by Baier, in *Supplementa Oryctographiæ Noricæ, Tab.* III, *fig.* 3, 4.

Fossil remains of the genus *Ophiura* are very rarely to be met with. A specimen is figured by Bourguet, *Traité des Petrifications, Planche* LIX, 438, in which a considerable portion of the central part of the animal of one of the species is preserved. A very perfect specimen of this genus, imbedded in chalk, was purchased by Mr. Donovan at the sale of the Leverian Museum.

Fragments of the genus *Asterias* are found more frequently than of the preceding genera; and, of the scutellated sort, more frequently than of the radiated. A fossil specimen of the former, approaching to *Pentagonaster semilunatus* of Linck, is figured by Schultz, *Bertrachtung der Versteinerten, Tab.* II, *fig.* 6, from Pirna. A similar specimen is figured, *Organic Remains, Pl.* I, *fig.* 1; and at *Pl.* I, *fig.* 3, is represented a chalk fossil resembling *Pentagonaster regularis,* Linck; *Asterias regularis,* Lamarck. Mr. Knorr gives the figure of an impression in flint of an asterite of this kind.

A fossil, in a yellowish coloured limestone, in the writer's cabinet, bears a tolerably close resemblance to *Astropecten echinatus minor,* Linck, *Tab.* VIII, No. 12. Some fragments of an asterite apparently similar are figured in the supplement to Knorr's work, *Pl.* VII, *Book* III; and a petrification, somewhat similar, from Malesme, in France, is figured by Guettard, *Mem. de l'Acad. An.* 1763. Similar fossils are also found in the blue clay of Sheppey island. Fossils of minute animals approaching to some of the preceding genera, deserving careful examination, appear to exist in St. Peter's mountain, and in the neighbourhood of Verona.

The facts which had been pointed out in a preceding work, respecting the structure of such of the encrinital and pentacrinital remains as were then known, evinced that the animals to which they belonged ought not to be placed, as has been done by our justly celebrated teacher, Lamarck, among the *polypi natantes,* but rather among the *echinodermata radiata.* Agreeable to this opinion they were placed, in the present work, next to, but preceding this order of animals. Their most proper station in the scale of nature could not be so perfectly ascertained until further knowledge respecting their internal organization had been obtained. The examination made by Mr. Miller has furnished us with that information; he has shown that they well deserved to be considered as forming a distinct family; and his observations have also manifested that, both in their structure and habits, they agree with the *stelleridæ.* Thus far the anatomical observations of Mr. Miller have been in accordance with the opinions entertained by the present writer, who, however, would, had he been so happy as to have obtained an earlier view of Mr. Miller's labours, have been disposed to place the *Crinoidea,* from their greater complexity of structure, at the end of, rather than before, the *Stelleridæ.*

After having examined the distinctive characters of *Ophiura, Euryale,* and *Asteria,* and ascertained that neither of them approximated particularly to the *Crinoidea,* Mr. Miller proceeded to the examination of the *Comatulæ,* by which he discovered such a conformity of structure, and so many points of accordance, as to allow him to say that *Comatula* might be defined, with sufficient precision, as a *Pentacrinus* destitute of its column. But, as the characters hitherto given of *Comatula* do not allude to those parts of its organization which mark the link between it and the *Crinoidea,* Mr. Miller thought it necessary to propose the following new generic character :—

"GENUS. COMATULA.—An unattached animal, having a depressed orbicular body, formed of calcareous plates containing the viscera. The mouth in the centre (capable of being elongated into a proboscis), surrounded by tentaculated arms, or fingers, composed of numerous joints : near the base of the body, below the fingers or arms, many jointed auxiliary side-arms terminating in a hooked point."

It was found, on dissection, that the *Comatulæ* have series of calcareous secretions, or ossicula, exactly similar in their general plan and arrangement to the *Crinoidea,* and especially to the genus *Pentacrinus,* and intended, like theirs, to sustain muscular action: that, at the base of the subglobose body of the *Comatulæ* there exists a pentagonal plate, analogous in situation to the first columnar joint of the *Crinoidea;* and an interesting affinity was found to exist between the plates forming the pelvis of *Comatula* and of *Pentacrinus;* and it was manifested that the auxiliary side-arms proceeding from the pelvis-like plate of *Comatula,* the formation of their joints, and their hook-like terminations, resemble, in every particular, those of *Pentacrinus caput Medusæ,* only that they are much shorter, and formed of a less number of joints.

Having pointed out several other particular circumstances, proving the accordant structure of the *Comatula* and *Pentacrinus,* Mr. Miller observes, that "The *Scapulæ* resemble also those of the *Pentacrinus caput Medusæ,* but are much more angularly pointed at their superior surface, and are also tied laterally together by an integument.

"From each of the *Scapulæ* in the different species proceed either two arm-like fingers, or two arms, each of the latter formed of a common and cuneiform joint, from which, on one side the first finger, and on the other a continuation of the arm sets off, which, again, by the intervention of cuneiform joints, divides into two or more fingers, and then forms a hand like in other *Crinoidea.* Each joint of the arms and fingers sends off, from alternate sides, a tentaculum formed of many articulated small joints, resembling, in formation, those of *Pentacrinus caput Medusæ.* An integument extends over the abdominal cavity, the groove in the arms, fingers, and tentacula, and is, like that in *Pentacrinus,* also protected by numerous minute calcareous plates*."

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* A Natural History of the *Crinoidea,* or Lily-shaped Animals, by J. S. Miller, A.L.S., p. 131.

Echinidæ.—This order is filled by those animals which have been hitherto named Echini.

The Echinus is one of the radiated echinodermata of Lamarck, and is distinguished from the preceding section of this order, the *Stelleridæ*, by the mouth and vent being separate: the body, which is short, variously formed, and generally quinquepartite, is inclosed in a crustaceous, porous and spiniferous covering, formed by numerous polygonal assulæ, or little plates joined by finely serrated vertical sutures, crossed by others rather more linear: the whole is still farther connected by an investing cuticle.

The crust or shell readily separates into five triangular sections, one of which is represented, *Pl.* X, *fig.* 6: each of these is divisible into four sections; two larger, *a. a.* termed Areas, ornamented with roundish tubercles on which are articulated the larger spines; and two smaller, *b. b.* termed *ambulacra*, which are perforated by numerous pores, from which proceed retractile tubules, terminating in strongly adhering sucker-formed feet. Each of these five triangular sections dividing thus into four smaller, the whole crust, it appears, is formed of twenty vertical sections.

Besides the almost innumerable pores from which the feet proceed, there are other larger pores at the upper part of each section, for the exclusion of the ovæ: two large openings also exist for the mouth and vent. The mouth is always on the lower part, and in most kinds has in its middle five teeth, collected together and terminating in a firm point, bearing the appearance of enamel: these teeth are fixed in a testaceous craticular apparatus, which has been termed Diogenes' lantern. The vent is variously situated, and is surrounded by tubercles, from which generally proceed numerous spines.

The fossil remains of Echini are frequently found in so perfect a state of preservation, as must suggest many subjects deserving earnest inquiry: the most important of these is the degree of agreement of the fossil remains with the correspondent parts of the existing animals. But to make this comparison, it is obvious that knowledge must be obtained respecting those genera and species which have been already discovered, either in their recent or fossil states. To communicate this knowledge in the most correct and impressive manner, different systematic arrangements of these animals have been formed.

Among the earliest attempts of this kind was that of Dr. Woodward, in his catalogue of the foreign fossils in his collection: a sketch of it is given here, not only as serving to show the state of the science at that period, but as likely to be useful for reference, since many of our early writers on these subjects adopted the nomenclature which Dr. Woodward had employed.

Marine Echini.

Part I. Those having two openings and very small tubercles on the surface are called *Spatagi*.

Sect. I. Those having a remarkable groove at one side, *Cordiformes*.

Art. 1. With the openings at the sides, one under the groove, the other at the opposite side.

2. Cordiform *Spatagi*, with one opening in the middle of the base, the other in the groove,

Sect. II. *Spatagi*, having no lateral groove, and with both openings in the base of the shell.

Art. 1. With one opening in the edge of the base, and the other near to the opposite margin, called *Galeati*.

2. *Spatagi*, with one opening in the centre of the base, the other in the margin.

Divis. 1. With porous lines extending from the vertex to the margin.

Member 1. Of a conoidal figure, or *Pileati*.

2. Of a compressed form, or *Discoides*.

Divis. 2. With rows of lines proceeding from the vertex, but not reaching to the margin*.

Part II. *Echini*, in which the shell has only one opening, and that placed in the centre of the base.

Sect. I. *Echini*, set with very small tubercles, with ten rows of short lines not reaching to the margin, but so disposed as to form a figure on the surface resembling the leaf of cinquefoil, and therefore not improperly called *Pentaphylloides*.

II. *Echini* with larger and more prominent tubercles, and with rows of lines or tubercles reaching from the vertex to the mouth, called *Ovarii*†.

The indefatigable Klein, in his *Naturalis dispositio Echinodermatum*, published in 1734, not only improved the classification, but added considerably to our knowledge of these substances: from the situation of the mouth, he distinguished them into *Emmesostomi*, when the mouth was placed in the centre of the base; and *Apomesostomi* when out of the centre. When the *vent* was in the upper part, he designated them *Anocysti;* in the under part, *Catocysti;* and in the side, *Pleurocysti*. Considering these as classes, he formed the following arrangement, by placing under each of the three last as many of these substances as respectively accorded with the class, but which differed from each other in some respects as to their general form, and the situation of the mouth: these he subdivided, according to other less but constant distinctions, into genera.

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[*] These he instances in a specimen of *Scutum* or *Echinanthus*.

[†] In this arrangement of Woodward it will be observed that he divides these substances into two divisions; *Spatagi*, having two openings, and *Echini*, having only one opening, at the base of the shell.

Class	*Sect.*	*Gen.*
I. *Anocysti.*	I. *Cidaris**. (1)	I. *Miliares*
		II. *Variolatæ*
		III. *Mammillatæ*
		IV. *Coronales*
		V. *Corollares*
		VI. *Asterizantes*
		VII. *Assulatæ*
		VIII. *Botryoides*
		IX. *Toreumaticæ*
	II. *Clipei.* (2)	
II. *Catocysti.*	I. *Fibulæ.* (3)	I. *Conuli*
		II. *Discoides*
	II. *Cassides.* (4)	I. *Galeæ*
		II. *Galeolæ*
	III. *Scuta.* (5)	I. *Angularia*
		II. *Ovata*
	IV. *Placentæ.* (6)	I. *Mellitæ*
		II. *Laganæ*
		III. *Rotulæ*
III. *Pleurocysti.*	I. *Arachnoides.* (7)	
	II. *Corda marina.* (8)	I. *Spatangi*
		II. *Spatagoides*
	III. *Ova marina.* (9)	I. *Brissi*
		II. *Brissoides.*

* As most of the terms employed for these sections have been since adopted as the names of genera, it was thought proper to subjoin the general characters of the substances to which they were here applied.

(1.) *Cidaris.* Turban-formed, with areas ornamented with prominent tubercles and porous ambulacræ; the mouth in the centre of the base, the vent in the apex.

(2.) *Clipeus.* Round, shield-formed; the mouth nearly in the centre of the base; the vent at nearly the same distance on the other side of the centre of the apex.

(3.) *Fibulæ.* Conical or discoidal; the mouth in the centre of the base, the vent in the margin.

(4.) *Cassis.* Helmet-formed; the mouth and vent at the opposite ends of the base.

(5.) *Scutum.* Angular or ovate shield-formed; the ambulacra crenated and porous, disposed in the form of five petals; the mouth in the centre, and the vent near the margin, in the base.

(6.) *Placenta.* Nearly flat; the upper surface slightly convex; lower flat; margin acute; the mouth in the centre; vent nearly mid-way between the mouth and the margin.

(7.) *Arachnoides.* Placenta-formed; the mouth in the centre; the vent square on the upper surface, at the margin.

(8.) *Corda marina.* Cordiform; the smaller end truncated, the mouth labiated, near the larger end of the base; the vent in the truncated smaller end.

(9.) *Ova marina.* Egg-formed; smaller end truncated; mouth labiated near the larger end of the base; the vent in the truncated smaller end.

Breyn, in *Schediasm. de Echinis*, reduced the number of genera to seven, forming them upon the situations of the mouth and vent, and assuming, for his groundwork, the sections of Klein as genera.

Genus	I.	*Echinometra* -	*Cidaris of Klein.*
	II.	*Echinoconus* -	*Fibula of ditto.*
	III.	*Echinocorys* -	*Cassis of ditto.*
	IV.	*Echinanthus* -	*Scutum of ditto.*
	V.	*Echinospatagus*	*Spatangus and Spatagoides of ditto.*
	VI.	*Echinobrissus* -	*Brissus and Brissoides of ditto.*
	VII.	*Echinodiscus* -	*Placenta and Arachnoides of ditto.*

Van Phelsum, adopting almost the whole of the genera suggested by Klein, and being under the necessity of forming new ones, rendered his classification too extensive, forming them into twenty genera.

Genus	1.	*Echinus* - - -	*Cid. Miliaris, Klein.*
	2.	*Echinometra* -	*Cid. Variolata and Mammillaris, ditto.*
	3.	*Echinosinus* - -	*Clipeus, ditto.*
	4.	*Echinites* - - -	*Conulus, ditto.*
	5.	*Echinoneus* - -	
	6.	*Echinodiscoides* -	*Discoides, ditto.*
	7.	*Echinodiscus* -	*Laganum, ditto.*
	8.	*Echinoplacos* -	*Mellita, ditto.*
	9.	*Echinocyamus* -	
	10.	*Echinus salinaris*	*Galea and Galeola, ditto.*
	11.	*Echinus pelagius*	*Galea, ditto.*
	12.	*Echinomitra* - -	*Conulus, apice obtuso, ditto.*
	13.	*Echinanthus* - -	*Scutum, ditto.*
	14.	*Echinorodum* -	*Scutum, ditto.*
	15.	*Arachnoides* - -	
	16.	*Amygdala* - -	*Brissoides, ditto.*
	17.	*Ova* - - - -	*Brissoides, ditto.*
	18.	*Nuces* - - - -	*Brissus, ditto.*
	19.	*Campana* - - -	*Spatangus, ditto.*
	20.	*Echinocardium* -	*Spatangus and Spatagoides, ditto.*

Aided by these labours, N. G. Leske, Professor of Natural History at Leipsic, in his Additamenta ad Jacobi Theodori Klein, Naturalem Dispositionem Echinodermatum, &c. formed the following arrangement of these animals, which was published in 1778:—

O. *Echinus.*

Genus I. *Cidaris.*	Genus VI. *Echinanthus* §.
II. *Clipeus.*	VII. *Echinodiscus* ‖.
III. *Echinites* *.	VIII. *Echinocyamus* **.
IV. *Echinoneus* †.	IX. *Echinarachnius* ††.
V. *Eckinocorys* ‡.	X. *Spatangus* ‡‡.

* Klein, it may be seen, p. 103, had divided his section *Fibula* into two genera, *Conulus* and *Discoides*; but Leske seeing no material difference between these two genera, included them in one under the name of *Echinites*; being evidently led to this from the variety of figures assumed by the casts of this genus, which, from their very frequent occurrence in various parts, had acquired the name of *Echinites vulgares*; and which, in many instances, have so depressed an appearance, and are so rounded at their top, as hardly to possess a conical figure. These different forms Klein considered as constituting merely so many varieties; whilst Phelsum, regarding them as so many distinct species, gave to them specific names adapted to their forms. These differences were, however, considered by Leske, as dependent on compression, which he supposed might have taken place during the process of petrifaction, and therefore he could not so separate them.

Another circumstance requires to be taken into consideration:—In numerous specimens that have not suffered mutilation by fracture, it appears that this form has proceeded from a deficiency of the infiltrated siliceous matter of which the casts have been formed. They have evidently been subjected to this infiltration whilst placed in their natural situation, on their base, and hence have been filled chiefly from below upwards; and, consequently, if from any circumstance the infiltration has ceased before the mould has been filled, the more pointed upper part would be wanting, and the remaining part would be nearly level or rounded on its upper surface. Others, indeed, possessed originally a compressed discoidal figure; but these, as well as those which have been just described, are considered by Leske as properly referrible to *Conulus.* No reason is offered by this attentive observer, nor does any appear, for their being placed under a genus bearing another name.

† This genus was formed by Phelsum, and agrees, as is observed by Leske, with the *Discoides* of Klein, except in the periphery being ovate, or oval rounded, and never angular, and the vent being oblong and nearer to the mouth.

‡ In this genus he includes the two genera *Galea* and *Galeola* of Klein.

§ Includes all the scutiform echini of Klein, whether ovate or angular.

‖ Is substituted for the *Placenta* of Klein—it had been previously adopted by Breyn.

** This is a new genus formed by Phelsum, the generic characters of which are Nuciform; ten stelliform, biporous, ambulacra; the mouth and vent near to each other, about the centre of the base.

†† This agrees with *Arachnoides* of Klein, the name only being changed.

‡‡ The sections of Klein, *Cor Marinum*, divided into the genera *Spatangus* and *Spatagoides*, and the section *Ovum marinum* divided into *Brissus* and *Brissoides*, were, after much consideration, included by Leske in this genus *Spatangus*; he separating the members of this genus into four families.—1. *Cordated Spatangi*, with a sulcated vertex.—2. *Cordated Spatangi*, not sulcated.—3. *Brissi*, oval spatangi, the ambulacra sulcated.—4. *Brissoides*, oval spatangi, not sulcated.

M. Leske concludes with particularising some fossil Echinites, which he thinks might serve to form a new genus between Echinanthus and Spatangus; they agreeing with the former in the situation and structure of the mouth, and, with the latter, in the situation of the vent.

Le Chev. de Lamarck, to whom the lover of natural history is so much indebted, afterwards proposed a considerable change in the arrangement of these animals, and in the denominations by which they should be distinguished, employing the form and size of the ambulacra among the generic distinctions.

The arrangement thus made was the following*:—

Division of Echinideæ.

1. The vent below the margin, in the lower surface, or in the margin.

* The mouth beneath, always central.

Scutella *Clypeaster* *Fibularia*	Ambulacra contracted.
Echinoneus *Galerites*	Ambulacra complete.

** The mouth beneath, not central, but approaching to the margin.

Ananchites.
Spatangus.

2. The vent above the margin, and consequently dorsal.

a. The vent dorsal, but approaching to the margin.
Cassidulus.
Nucleolites.

b. The anus dorsal and vertical; the shell regular.
Echinus.
Cidarites.

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* Histoire Naturelle des Animaux sans Vertebres, Tom. III, p. 6.

Scutella, the first genus, comprises *Placenta* of Klein (*Echinodiscus* of Breyn and Leske), and *Echinarachnius* of Klein and Leske.

The admission of *Echinarachnius* within the limits which Lamarck has prescribed to this genus cannot be allowed. The ambulacra, extended only to the margin, and the mouth placed on the upper side of the margin, must exclude it from a genus, comprised in a section, the members of which are described as having the ambulacra complete, and the mouth beneath the margin. Of the name of the genus, it may be observed, that it is not more expressive than that which it is proposed to supersede; and is, besides, the diminutive of the word (*Scutum*), by which another widely different genus has been designated.

Clypeaster is a new, but does not appear to be a more distinctive, name for this genus than *Scutum* of Klein, or *Echinanthus* of Leske, Breyn, &c.

Fibularia is proposed as a denomination preferable to that of *Echinocyamus*, which had been adopted for this genus by the assiduous Phelsum. No reason, however, for this preference appears, and the term, *Fibularia*, is so far objectionable, as it resembles *Fibula* employed by Klein, with equal propriety, for a section including echini of very different characters.

Echinoneus is applied in the same manner as by Lamarck.

Galerites is assumed as appropriate to the genus the first species of which is *Conulus albo-galerus* of Klein, and is followed by those other fossil echini to which have been applied the more apt name of *Conulites*.

Ananchytes is employed in the place of *Cassis* of Klein, or of *Echinocorytes* of Leske.

Spatangus is applied nearly in the same manner as by Leske; its species are divided into those with four and those with five ambulacra.

Cassidulus is the name of the genus proposed by Lamarck for the reception of those echinites which Leske described as having the mouth in the centre of the base, and the vent above the margin, possessing, as it were, those generic characters which would form a genus between *Echinanthus* and *Spatangus*.

Nucleolites.—The echinites of this genus are admitted, by Lamarck, to agree so closely with those of the preceding genus, that they might be united; the only material difference being, that the ambulacra in the *Cassiduli* are contracted, but, in the *Nucleolites*, are radiated to the mouth.

The genus *Cidaris* is divided, by this naturalist, into two genera. The one, named by him *Echinus*, is intended to comprise all those species which have the tubercles, on which the spines are placed, entire; the other, distinguished as *Cidarites*, contains all those whose tubercles are perforated for the transmission of what is considered to be a muscular cord. The species of this latter genus he divides into two families, the turbans and the diadems.

In forming the following arrangement, the classification of Lamarck being the latest, and having the sanction of a name so justly celebrated, has been almost exactly followed.

From the situations of the mouth and of the vent are formed the chief generic distinctions. When the mouth is central, the echini are said to be *Emmesostomous*; and when towards the margin, *Apomesostomous:* when the vent is in the vertex, they are distinguished as *Anocystous*, when in the base as *Catocystous*, and, when in the side, as *Pleurocystous*. The more obvious circumstances dependent on the ambulacra, and on the general form and surface, complete the characters of each genus. From the more subordinate distinctions of form, &c. result the several specific characters.

O. Echinus.

			Situation of the Mouth.	Situation of the Vent.	Ambulacra.	
Emmesostomi	I. *Echinus* - -	*Anocystous*	central	vertical	banded, complete.	*Pl.* II, *fig.* 1
	II. *Cidaris* - -					
	III. *Clipeus* - -		subcentral	nearly vertical	petaloidal on the upper and banded on the lower surface.	6
	IV. *Cassidulus* -	*Pleurocystous*	subcentral	lateral	petaloidal.	7
	V. *Nucleolites* -		subcentral	lateral	banded, complete.	*
	VI. *Echinarachnius*		central	marginal, above	diffusedly petalloidal.	8
	VII. *Galerites* -	*Catocystous*	central	beneath, nearly marginal	banded, complete.	3
	VIII. *Clypeaster* -		central	beneath, nearly marginal	petaloidal.	2
	IX. *Scutella* - -		central	between mouth & margin	petaloidal.	10
	X. *Fibularia* -		central	near the mouth	petaloidal.	4 & 5
	XI. *Echinoneus*		subcentral	near the mouth	banded, complete.	†
Apomesostomi	XII. *Ananchytes*	*Pleurocystous*	near the margin	opposite margin	banded, complete.	9 & 12
	XIII. *Spatangus* -		near the margin	opposite side	petaloidal, unequal.	11

* This genus differing from the preceding only in the ambulacra being extended to the centre of the base, a figure, in illustration of it, does not appear to be necessary.

† It was not thought requisite to illustrate this genus by a figure, since it differs from the preceding only in its extended complete ambulacra, and in possessing a more discoidal form.

GENUS I. *Echinus.*—With a roundish, testaceous or crustaceous internal skin, inclining to oval; the mouth beneath, and central, armed with five ossiculæ; the vent vertical. Ten areas, five large and five smaller, set with imperforate tubercles for the articulation of spines; and ten porous ambulacra, or bands, interposed between the areas, are disposed vertically from the mouth to the vent. *Pl.* II, *fig.* 1.

It has been thought advisable to adopt, with Lamarck, the division of *Cidaris* of Klein, Leske, &c., into two genera, *Echinus* and *Cidaris:* the former having the tubercles entire, and the spines which are set on them, moved only by the muscular fibres in the investing cuticle; the latter having them perforated through their centre, for the passage of a muscular cord, which, being attached to the base of the spines, serves to augment and to direct their motions *.

The *Echini* are distinguishable, not only by their imperforated tubercles, but by the spines which are articulated on these tubercles, which are simple in their forms, and either smooth or very finely granulated. In some, which have somewhat of an oval form, the spines are of different sizes and shapes on the same shell; these are considered as approximating to *Cidaris.* The ambulacra are not here so regularly formed, nor so distinctly separated from the areas, as in those species which belong to the other genus.

Sp. 1. *E. esculentus.*—Subglobose, rather hemispherical; areas, with tubercles not large. The ambulacra with six rows of pores, disposed obliquely; the spines acicular. Recent and fossil.

2. — *saxatilis.*—Suborbicular and rather depressed;

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* It must be observed, that the difference, forming here a generic characteristic, may be found in the individuals of another genus. *Spatangus purpureus* has its tubercles perforated.

eight rows of tubercles in the larger areas, the third from the sides larger than the rest; four rows in the lesser. The ambulacra narrow, with three double rows of pores; the spines acicular and longitudinally striated. Recent and fossil.—*Leske ap. Klein, Tab.* XXXI, *fig. A, D.*

3. *E. angulosus.*—Rather depressed, and subangular; two rows of larger tubercles in both large and small areas, surrounded with smaller. The ambulacra with three double rows of pores, the outer ones in a straight, the inner ones in zigzag lines. Recent and fossil.—*Leske ap. Klein, Tab.* II, *fig.* 7.

4. — *excavatus.*—Nearly hemispherical; the areas with two rows of miliary, surrounded by granular tubercles; the ambulacra depressed as if excavated, and having a double row of alternating pores. Fossil.—*Leske ap. Klein, Tab.* XLIV, *fig.* 3, 4.

5. — *fenestratus.*—Roundish, the base smooth and widely open; the larger areas with six rows of tubercles, the two intermediate rows largest; the smaller areas with two rows of larger tubercles; the surface of the areas granulated with minute tubercles. The ambulacra granulated and pierced with three pair of pores, transversely slanting; the spines setose. Recent and fossil.—*Leske ap. Klein, Tab.* IV, *fig.* 3.

It is doubtful if *Ech. lucunter* is not a variety of this species.

6. — *rupestris.*—Subelliptical; areas with two rows of larger tubercles, with smaller ones between in a serrated line; the ambulacra with the pores in curved lines; spines acicular. Recent and fossil.—*Leske ap. Klein, Tab.* V, *fig. a, b, c.*

7. — *variegatus.*—Orbicular, rather depressed; larger areas with tubercles of a medium size; smaller ones a little more raised, with three rows of smaller tubercles;

ambulacra with three pairs of rows of pores; mouth nearly round, slightly waved; vent round. Recent and rare.—*Leske ap. Klein, Tab.* X, *fig. B, C.*

8. *E. pustulosus.*—Hemispherical and depressed; larger areas with medium-sized tubercles, beginning at the ends with, and extending in the middle to six, in transverse rows; smaller areas with two longitudinal rows of smaller tubercles; ambulacra with four or five pairs of rows of pores, wide towards the mouth; the mouth large, widely sinuous; vent small. Recent. —*Leske ap. Klein, Tab.* XI, *fig. A, B, C, D.*

9. — *granulatus.*—Suborbicular, slightly angulated; larger areas with seven rows of smallish tubercles on each side, leaving a space in which the joining of the assulæ is seen; smaller areas with four rows on each side; ambulacra with pores in three pairs of rows, disposed in quincunx order; mouth rather small, slightly winding; vent circular. Recent.—*Leske ap. Klein, Tab.* XI, *fig. E, F.*

10. — *tesselatus.*—Suborbicular, slightly conical; areas showing the assulæ, and bearing slight traces only of a row of tubercles; ambulacra with two rows of closely-set pores; mouth circular, small, and turned inwards; vent small. Fossil.—*Leske ap. Klein, Tab.* XI, *fig. G.*

11. — *botryoides.*—Subglobular; larger areas with two rows of largish tubercles; those of the smaller not discoverable with precision, but these areas are more raised than the larger; ambulacra with two rows of transversely bent lines of pores. Fossil.—*Leske ap. Klein, Tab.* XI, *fig. H.*

12. — *toreumaticus.*—Nearly hemispherical; vertex rather raised; areas with two rows of tubercles with crenated margins surrounded by granular tubercles, almost to the ambulacra. The larger areas have four rows of excavated transverse lines, two of which

lie nearest to the ambulacra, and separate them from the largest tubercles, and two are placed within the rows of tubercles; the outer and inner rows of lines are opposed to each other, alternating with the tubercles, whilst the inner adjacent rows alternate with each other. In the lesser areas only two rows are placed between the tubercles; these excavated lines exist only from the vertex to the widest part of the periphery. Ambulacra with pores disposed in serrated rows; mouth small, retracted. Recent and fossil.—*Leske ap. Klein, Tab.* X, *fig. D, E.*

13. *E. pentagonus.*—Pentagonal and subpyramidal; the sides nearly flat; the porous fasciæ with two rows of pores; the areas, on the upper part, with but few small tubercles, but, on the lower, thickly set with tubercles surrounded by circles. Fossil, found in the upper oolite.

This species is very interesting: its form is so decided as to authorise it to be considered as possessing a depressed, obtuse, five-sided subpyramidal form. The upper parts of all the areas are remarkably bare; but, about the rounded margin, the verrucæ, surrounded by rings, as in *Echinanthus,* become frequent, and, particularly over the whole of the base, they are set very thickly, but distinctly, between the interposed biporous bands.

The descriptions given, by Lamarck, of several of the species of *Cidaris,* brought by MM. Peron and Le Sueur, give reason for believing that the recent analogues of more of our fossil echini may be discovered in the South Seas.

14. — *virgatus.*—Hemispherical, rather raised; subventricose, assulæ apparent; the middle of the areas thin of tubercles, and striped with violet; the ambulacral bands with three double rows of pores. Recent. —*Lam.*

15. *E. globiformis.*—Nearly spheroidal; red or orange coloured, with white-eyed tubercles; four rows of pores in the areas. Recent.—*Lam.*

16. — *polyzonalis.*—Hemispherical, rather depressed; subpentagonal; greenish, with transverse white zones decussating white porous rays; the lower surface concave. Recent.—*Lam.*

17. — *maculatus.*—Hemispherical; white, with spots of a greenish yellow disposed in transverse zones; areas slightly verrucous. Recent.—*Lam.*

18. — *variegatus.*—Hemispherically globose, variegated with green and white; the pores in two pairs of rows at the sides of the areas; the spines green. Recent.—*Lam.*

19. — *bigranularis.*—Hemispherical, rather depressed; ambulacra rather bare; the pores in four rows; the areas with large tubercles in double rows. Fossil.—*Lam.*

20. — *arenatus.*—Hemispherical; ambulacra with pores in four rows; the tubercles of the largest areas but small, the rest as if covered with sand. Fossil.—*Lam.*

21. — *sardica.*—Orbicular, depressed; base nearly flat; areas multifariously tuberculated; the larger with eight or twelve, the smaller with four or six rows. A suture passes down the middle of the areas. Ambulacra sunken, with five double rows of pores; mouth small, with ten grooves. Recent, large as a child's head. Tuscan and Adriatic Sea.—*Leske ap. Klein, Tab.* IX, *fig. A, B.*

22. — *flammea.*—Nearly hemispherical, depressed; the larger areas with twelve rows of tubercles at the broader part; the less, more raised, and with three rows in the middle part; ambulacra narrow; mouth small. Recent.—*Leske ap. Klein, Tab.* X, *fig. A.*

23. — *mammillata.*—Subelliptical, depressed; six-

teen or eighteen imperforate papillæ in the larger areas, and fourteen in the smaller, the largest being about the margin, and followed by others of a middling size: all encircled by others of a granular appearance; the ambulacra rising broad from the mouth with four or five pairs of pores, and terminating in one sinuous pair; the mouth large, and the vent pentangular *. Recent and fossil.—*Leske ap. Klein, Tab.* VI.

GENUS II. *Cidaris.*—With a spheroidal or depressed orbicular crustaceous or testaceous internal solid skin, furnished with tubercles perforated through their summits, supporting moveable spines, the largest of which are bacciliform. The ambulacra are complete, reaching from the vertex to the mouth, and bordered by two multiporous bands. The mouth beneath, central, and supplied with teeth. The vent above, vertical.

In the species of this genus, in which the tubercles are pierced through their apex, for the passage, it is presumed, of a muscular thread, the ambulacra are narrower and more regular than in those in which the tubercles are imperforate; the little porous bands, too, which border the ambulacra are less diverging and more nearly approximated. Their spines are various, never uniformly setous, but either large and sudiform and as if truncated, or long and crenulated, with others very small and numerous, surrounding, as with a little collar, the base of the larger ones. In some of the species of this family, the margins round the papillous tubercles are regularly crenulated. Lamarck divides these echini with perforated spines into turbans and diadems. By the former term he designates those which are rather elevated, but nearly spheroidal, with the ambulacra winding; by the latter he means those which have a round depressed shell, with straight ambulacra, and with spines generally hollow.

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* Spines are of the pallisadoe kind, *sudes fortalitiorum*, Klein; and are placed on the large mammillary tubercles; small, spatulous ones being attached to the smaller tubercles. Some of the fossil specimens resembling this species deserve rather to be considered as distinct species, having very long cylindrical spines, denticulated in longitudinal striæ.—Some in the writer's collection are more than three inches in length.

Sp. 1. *Cid. imperialis.*—Subglobose, depressed on both sides; the ambulacra and smaller spines of a violet colour; the larger spines cylindrical, but rather ventricose, striated in their apex, and marked with white rings.

Cid. papillata major.—Leske ap. Klein, Tab. VII, *fig. A.*

This *Cidaris* differs from *Cidaris mammillata, Kl.* in its shell being more globular, and in its tubercles being pierced.

2. *C. diadema.*—Nearly circular: the vertex depressed; the base rather convex; the mouth large, and the vent circular. The larger areas have two rows of large tubercles next the ambulacra; between which are two rows of small, surrounded by others still smaller. These tubercles are pierced in their tops, and their surrounding rings are finely crenulated. The ambulacra are bordered, and have three pair of rows of pores in their widest part, which lessen as the space is contracted. The spines are acicular, and are surrounded at their base with a ring, within which is the excavated bulb that articulates with the perforated papillary tubercle. Recent and fossil.—*Leske ap. Klein, Tab.* XXXVII, *fig.* 1, 2.

3. —*papillata.*—Orbicular, but the vertex depressed and the base flattish; the areas with two rows in each of perforated papillæ, each surrounded by a circle of granular tubercles and punctured spaces. Between each two winding biporous bands, or ambulacra, a band is raised which corresponds with the smaller areas: the mouth is nearly round; the vent varies in its

form. Recent and fossil.—*Leske ap. Klein, Tab.* VII.

In some fossils, probably of this species, the spines assume a ventricose, clavated form. These have been long known by the name of *Lapides judaici.*

4. *C. atratus.* — Ovately hemispherical, rather depressed; of a violet colour, inclining to black. The tubercles large; the dorsal spines short, obtuse, and imbricated; those at the circumference subspathulated. Recent.—*Cid. violacea,* Leske.

5. — *crenularis.* — Subglobose; with two rows in the larger areas of large tubercles, crenulated round the papillæ. Fossil, from Switzerland.—*Bourguet Petrif. Tab.* LII, 344, 347, 348.

6. — *pseudo-diadema.* — Depressedly hemispherical; the bands straight and biporous; and two rows of large tubercles in each area. Fossil.

7. — *calamaris.*—Spheroidal, rather depressed; the larger areas, with distant papillary tubercles, surrounded by a granular surface; two rows of tubercles in the smaller. The ambulacra, with pores, in four divisions; the spines hollow, and possessing much of the structure of a quill. Recent.—*Leske ap. Klein, Tab.* XLV, *fig.* 1-4.

8. — *radiata.*—Circular, depressed; the vent surrounded by plates forming a star of five angularly pointed rays, with a foramen in the point of each ray. From each termination of these rays proceed two other rays forming another star; these, being the ambulacra, are pierced with numerous pores. The interstices, or areas, are filled with differently sized tubercles. On the base is also a stelliform expansion, in the middle of which are five semilunar openings.

This is a large recent echinus; *Echinanthus major,* Seba.—*Komet groote,* Phelsum.—*Leske ap. Klein, Tab.* XLIV, *fig.* 1.

The following fossils appear to belong to this genus, but their specific characters are not so obvious:—

9. *Coronalis.*—Nearly hemispherical; the areas alternately wide and narrow, with scattered papillæ; the ambulacra flat, uniting at the top, and forming a flat space round the vent. Fossil.—*Leske ap. Klein, Tab.* VIII, *fig. A, B.*

10. *Corollaris.*—Various siliceous *nuclei* have been placed under this head which have doubtlessly belonged to different species of *Cidarites.*—*Leske ap. Klein, Tab.* VIII, *fig. C.*

The fossil specimen, named *Cidaris asterizans,* by Klein, does not appear to deserve, as is justly observed by Leske, to be considered of a different species, being a spathose fossil of *C. diadema,* or of one of its varieties, the striæ, in the engraving, having been too much *helped* by the artist.—*Leske ap. Klein, Tab.* XLVI, *fig.* 5.

GENUS III. *Clypeus.*—Of a roundish subconical form; the base rather concave; the mouth beneath, nearly central; the vent near the apex; the ambulacra bowed, striated across, bordered by pores, and disposed in five pairs, each pair forming a petaloidal figure, and are then continued in the form of bands to the mouth. The smaller areas are contained within the petaloidal figures, and the larger surround the ambulacra, and are extended over the rest of the surface, which is covered with small tubercles, separated from each other by distinct circlets. *Pl.* II, *fig.* 6.

Synon. *Echinobrissus,* Breyn.

Sp. 1. *Cl. sinuatus.*—Nearly orbicular, depressed; one of the larger areas is divided by a longitudinal groove, commencing near the apex and continued nearly to the margin; the ambulacra are bowed and broad, are transversely divided by bars, leaving intervening openings, and are bordered by rows of thickly set pores; each pair of ambulacra approximate towards the margin, and thus almost enclose the smaller areas. The base is divided by five bands, proceeding from the ends of the petaloidal ambulacra and terminating at the mouth; the mouth is small and pentagonal; the vent opened laterally in the apex of the groove which exists in the upper surface.

This is the polar stone of Plott.

No recent species of this genus is known.

This genus is not even mentioned by Lamarck: and the first species here noticed is offered by him interrogatively, as similar to *Galerites umbrella*, with which, however, it does not agree, since one of the generic characters of *Galerites* is the having of the vent placed in, or beneath and near to, the margin.

2. *Cl. conoideus.*—A spathose petrifaction; the figure conoidal; the circumference subrotund, inclining to the elliptical. The divisions and situations of the areas, with the structure of the ambulacra, and the nature of the surface, point this fossil out, in the opinion of Leske, as being a species of this genus.

Cl. hemisphæricus and *Cl. quinquelabiatus* are names given to two mutilated fossil specimens, possessing, in Leske's opinion, uncertain claims to places under this genus. The first, he thinks, resembles *Galea Wagrica,* Klein; and the second does not appear to have been in a state, the vent not being discoverable, to allow a correct judgment being formed respecting even its generic characters.

GENUS IV. *Cassidulus.*—Ovate or subcordiform, and rather raised; the mouth beneath, subcentral; the vent at one end, considerably above the margin; the ambulacra porous, subpetaloidal, and reaching nearly to the margin. *Pl.* II, *fig.* 7.

These echinidæ were pointed out by Leske as requiring to be placed under a distinct and new genus, the mouth being placed nearly in the centre of the base, and bearing the character of *Echinanthus*; the vent situated on the upper part of one end, as in *Spatagus*. Leske having declined giving a name to the genus, it received it from Lamarck.

Sp. 1. *Cass. pyriformis.*—Ovate and gibbous, the base rather flat; the surface, particularly of the base, tubercular; and the back slightly carinated; the ambulacra obsoletely porous; the mouth roundish, subpentagonal, and with five rather prominent lips; a double row of pores, forming a five-rayed star, round the mouth; the vent round. Fossil.

2. — *lapis cancri.*—Convex and obtusely ovate; the vertex excentric and perforated with four pores; the ambulacral lines of pores double, and forming subpetaloidal figures, with the terminations open; the mouth not exactly in the centre, but nearer to the narrower end; the vent round. Fossil.

3. — *patellaris.*—Oval and flattish; the back very slightly raised, and the base as slightly concave; the ambulacra biporous; the pores linearly connected in the form of a star, and rather separated from the rest of the surface by an obsolete line.

Lamarck, who considers that the characters of the ambulacra should be reckoned among the distinguishing generic characters, has instituted the following genus for the reception of such of the echinidæ as accord with the preceding genus, *Cassidulus*, in every respect, except in the state of the ambulacra. These, in this genus, reach only to the margin; but those which belong to the following genus are extended to the centre of the base.

GENUS V. *Nucleolites.*—Ovate or subcordiform, rather raised; the mouth beneath and subcentral; the vent at the end, much above the margin; the ambulacra radiating to the centre of the base.

Synon. *Echinobrissus,* Breyn.

Sp. 1. *Nucl. scutata.*—Elliptical and rather quadrilateral; slightly convex and widest behind, where it is sulcated; vent dorsal. Fossil.

Lamark places under this species, *Spatagus depressus* of Klein. This is an interesting fossil. From its form and sulcus, and from the situation of the mouth and vent, it approximates to *Clypeus;* and, from its four radiating ambulacra, with the fifth passing along the sulcus, it resembles *Spatagus.*

2. — *colombaria.*—Obovate, rather elevated, and widest behind; ambulacra with biporous lines, with faint striæ; the mouth pentagonal. Fossil.

3. — *ovulum.*—Ovate and pulvinated; with thinly scattered tubercles with surrounding rings; the ambulacral lines subbiporous. Fossil.

4. — *amygdala.*—Ovate and rather gibbous, the vertex rather prominent; the ambulacra very narrow; the vent beneath a small projection. Fossil.

A figure illustrative of this genus appears to be unnecessary, as it would differ from that of the preceding genus only in the form of the ambulacra.

GENUS VI. *Echinarachnius.*—Circumference subpentagonal; the upper surface slightly raised, rather conoidally, in the centre; the under surface flat; the areas separated by ten tortuous crenated lines; and immediately between the approximating larger areas are interposed five straight slightly sulcated lines, which, passing over the margin, are extended to the mouth; thus dividing the surface into five equal parts. The mouth is beneath, and central; the vent square, on the upper side, close to the margin.

The whole of the surface is marked by elegant tracings, as if with ink, bearing somewhat of the appearance of a spider's web. *Pl.* II, *fig.* 8.

But one species is known, which has only been seen recent, and is placed by Lamarck under his genus *Scutella;* but the situation of the vent, decidedly on the upper surface, appears to claim for it a distinct genus.

GENUS VII. *Galerites.*—Conoidal or subpyramidal, rising from nearly a circular base, and terminating in a vertex more or less obtuse; the mouth beneath, central; the vent beneath, in or near to the margin; the surface divided into larger and smaller areas by ten pair of ambulacral lines passing from the vertex to the mouth, the area in which the vent is placed being the largest. *Pl.* II, *fig.* 3.

Synon. *Conulus,* Klein. *Echinites,* Leske. *Echinoconus,* Breyn.

No remains of these animals are known to exist but in a mineralised state. These petrifactions have been distinguished by various appellations—*Scolopendritæ, Bufonitæ, Cap-stones,* &c.

Sp. 1. *Gal. albogalerus.*—Conical; circumference subovate, there being a slight extension on that side in which the vent is placed; the vertex perforated with five foramina, in the tips of the lesser areas; the surface is beset with minute tubercles, and the sutures connecting the assulæ are generally visible: the ambulacral lines of pores are placed close in straight double rows; the mouth round; the vent oval, the shell round it being vaultedly convex.—*Leske ap. Klein, Tab.* XIII, *fig. A, B.*

2. — *depressus.*—Circumference circular; the division of the areas marked by the sutures, but the assulæ not shown; the mouth rather small; the vent large and oval.

3. — *vulgaris.*—Under this vague and comprehensive

designation are placed those numerous small fossil specimens which are common in many parts of the world; possessing the characters of the genus, but varying so indeterminately in their minor distinctions, as not to allow of their being described as definable varieties. They are found, sometimes, to vary so in their figures, as if they were the members of some undescribed genus: instead of possessing the complete conical form, the vertex is depressed as if truncated; and sometimes the slight angles are entirely removed, and the sides are so rounded that the fossil possesses almost a globular form. Even the mouth and vent, though in their regular situation, are frequently found to vary in their size and form. The areas vary considerably, being sometimes raised, other times sunk; some bear the marks of the assulæ, and others not. The ambulacra vary in their breadth, as well as in their depth or elevation, and sometimes, but rarely, show the two lines of pores.

As these fossils, which are almost all siliceous casts, bear the markings of the inner surface of the shell which they filled, their surfaces must necessarily differ from the outer surfaces of the shells from which they proceeded; and endless, indeed, are the differences which have resulted from the various degrees of correctness in the casts, and which must have depended not only on the condition of the mould, but on the state of the injected matter and the degree of perfection to which the crystallizing process had been allowed to proceed.

4. *Gal. quaterfasciatus.*—Nearly globular or acutely conical; four small and four large areas divided by eight ambulacra; the mouth and vent quadrangular.

Fossil. Siliceous.

5. — *sexiesfasciatus*—Subconical; vertex obtuse; six large and six small areas, separated by twelve tubercu-

lated ambulacra; vent round, and larger than the mouth.
Fossil. Siliceous.

These fossils are exceedingly rare.

The following species are also particularised by Lamarck:—

6. *Gal. abbreviatus.*—Fossil, from France and Germany.

7. —*fissuratus.*—Fossil, from the north of Germany.

8. — *hemisphæricus.*

It is doubted whether this may not be the same as *E. subuculus* of Leske ap. Klein, *Tab.* XIV, *fig. L—O.*

9. — *depressus.*—Leske ap. Klein, *Tab.* XL, *fig.* 5, 6.

10. — *rotularis.*—This is referred to *Ech. subuculus* of Gmelin and of Leske, *Tab.* XIV, but is supposed to be dissimilar from *G. hemisphæricus.*

11. — *conoideus.*—Large; conoidal, nearly circular; the mouth transverse, surrounded by a hollow.
Fossil. Italy.

12. — *scutiformis.*—Resembles that figured by Klein, *Tab.* XLII, *fig.* 2, 3.

13. — *ovatus.*—Ovato-conoidal; depressed at the sides. Fossil.

14. — *semi-globus.*—Orbicular and hemispherical; the vertex excentrical.—Leske ap. Klein, *Tab.* XLII, *fig.* 5.

15. — *cylindricus.*—Cylindrical; short; the back rounded, but nearly flat.

16. —*patella.*—Orbicular, depressed, and rather convex; the ambulacral grooves elegantly striated; one of the areas excavated by a longitudinal groove.—*Encyclop. Pl.* CXLIII, *fig.* 1, 2.

17. — *umbrella.*—Is questioned as being *Clypeus sinuatus* of Klein, with which the description agrees; but Lamarck has not adverted to the vent in *Clypeus* being on the upper surface.

18. — *excentricus.*—Ovate, convexly gibbous; the

vertex excentrical, from which proceed four ambulacra; the lower side sulcated with five grooves.

This curious and irregularly formed fossil is described as being as large as the preceding. Its *habitat* is not mentioned.

19. *G. subuculus.*—Discoidal; vertex subrotund; base rather concave; the whole surface of the areas set with minute rings; the ambulacra biporous; the mouth small and circular; the vent even, minute, and circular; the vertex sometimes scutellated in those specimens in which the shell remains. Fossil.

Echinites subuculus of Leske, figured by Klein, *Tab.* XIV, *l, m, n, o.*

GENUS VIII. *Clypeaster.*—Oval, elliptical, subangular; sometimes raised and gibbous in the centre; the margin thick and rounded, the under side concave at the centre; the mouth, armed with six bony pieces, is beneath, and central; the vent beneath, and in or near to the margin; the ambulacra, on the upper surface, in a pentapetalous form. *Pl.* II, *fig.* 2.

Synon. *Scutum,* Klein. *Echinanthus,* Leske.

Sp. 1. *Cl. humile.*—Ovate; margin winding; ambulacra with two rows of pores connected by small transverse grooves, and so disposed as to form the sides of five petaloidal figures; the larger areas are disposed around, the smaller ones circumscribed by these ambulacra, and somewhat raised; the surface covered by granular tubercles, set in rings, with numerous smaller grains interposed; the base flat towards the margin, and concave in the middle; the mouth deeply seated in the centre, of an obtuse pentagonal form; the vent transversely oval. Recent and fossil.

2. — *altum.*—Subovate; vertex conoidal, considerably vaulted; areas granulated, the larger without, the smaller within, the petaloidal spaces formed by the ambulacra.

This species is only known in a petrified state. It is distinguishable by its size, being, sometimes, six inches long, and two inches in height, by its rising in a round vaulted form, and by its ambulacra being large and wide. Fossil.

The casts of the two last species form very interesting fossils, *Org. Remains, Pl.* II, *fig.* 8, and *Pl.* IV, *fig.* 7.

3. *C. ovatus.*—Ovate; the margin not waving, the upper part convex, with four pores in the vertex; the ambulacra, in petaloidal forms, not united at their lower terminations, but the one side of each ray extending farther than the other; the surface covered with minute tubercles; the base flat; the mouth subreniform, with five prominent lips, from the hollowed spaces between which proceed five grooves; the vent in the margin. Recent and fossil.

Leske ap. Klein, *Tab.* XX, *fig. c, d.*

4. — *orbiculatus.* — This is a fossil which was placed, by Leske, under this genus, with considerable doubt, it being so injured that the state of the under part could not be ascertained.

5. — *marginatus.*—With a convex stelliferous vertex; with short ovato-acute ambulacra; the margin rather thin, expanded, and broad.

Scilla, *Corp. mar. Tab.* XI, *fig. inferior.*

6. — *scutiformis.*—Elliptical; the back flattish and submarginated.

Seba. *mus.* III, *Tab.* XIII, *fig.* 23, 24. *Encyc. Pl.* CXLVI, *fig.* 1, 2.

7. — *laganum.*

Echinodiscus laganum. Leske ap. Klein, *Tab.* XXII, *fig. a, b, c.*

8. — *excentricus.*—Suborbicular, depressed, but rather convex; five narrow ambulacral compartments divaricating from the excentric vertex; the vent marginal.

Encyc. Pl. CXLIV, *fig.* 1, 2.

9. *C. oviformis.*

Echinanthus ovatus, Leske ap. Kl. *Tab.* XX, *fig. c, d.* Recent and fossil. Found in the South Seas.

10. — *politus.*—Ovate, inflated, and smooth; with five long narrow ambulacral compartments, open at their terminations. Fossil, from Sienna.

11. — *hemisphæricus.*—Orbicular, convex, and semiglobose; with five ambulacral divisions radiating from the excentrical vertex. Fossil.

12. — *stelliferus.*—Ovate and tumid; with five long narrow ambulacral divisions, the contained areas rather prominent.

Knorr. *Petr.* p. 11, *Tab.* E. III, *fig.* 5.

GENUS IX. *Scutella.*—Rather flat or discoidal; slightly convex on the upper surface; with four large pores in the vertex; the margin rather thin and acute; and the base flat. The ambulacra short, disposed in a pentapetalous figure; the mouth beneath, central; the vent beneath, between the mouth and margin. *Pl.* II, *fig.* 10.

The mouth is armed with five pieces, divided into two branches, and vertical irregular plates are interposed between the two branches.

Synon. *Placenta,* Klein. *Echinodiscus,* Breyn, Leske, and others.

Sp. 1.—*Scut. dentata.*—Orbicular, depressed; the disc entire; the posterior part of the margin dentated.

Leske ap. Klein, *Tab.* XXII, *fig. E, F.*

2. — *digitata.*—Orbicular, depressed; the disc pierced in the fore part by two or four openings.

Leske ap. Klein, *Tab.* XXII, *fig. A, B. Decius digitatus. Fig. C, D. Octies digitatus.*

3. — *emarginata.*—Orbiculato-elliptical, depressed; with six foramina, five of which cut into the margin.

Leske ap. Klein, *Tab.* L, *fig.* 5, 6.

4. — *sexforis.*—Orbicular, depressed, and as if trun-

cated; with six oblong foramina; the vent near to the mouth.

Leske ap. Klein, *Tab.* L, *fig.* 3, 4.

5. S. *quinquefora.*—Orbicular, depressed, and subreniform; with five oblong foramina; the vent near to the mouth.

Leske ap. Klein, *Tab.* XXI, *fig. C, D.*

6. — *quadrifora.*

This appears to be only a variety of *Scutella emarginata,* in which only two of the three posterior foramina reach the margin. It however differs in being somewhat subreniform.

7. — *bifora.*—Obtusely trigonal and depressed; with two oblong foramina at the posterior part; the vent distant from the mouth.

Leske ap. Klein, *Tab.* XXI, *fig. A, B.*

8. — *bifissa.*—Cordato-orbicular, depressed; with two slits on the wider side, and an intermediate, projecting, truncated lobe.

Echinus Auritus, Leske ap. Klein, p. 202.

9. — *lenticularis.*—Orbicular, rather convex; with five short ambulacra with open apices; the vent marginal. Fossil. Grignon.

10. — *orbicularis.*—Circular, and depressed towards the margin; the back rather convex in the centre; ovato-acute ambulacra; the vent between the mouth and the margin.

Leske ap. Klein, *Tab.* XLV, *fig.* 6, 7.

11. — *fibularis.*—Small, orbicular, depressed, and rather thick, the margin rounded; the vent between the mouth and the margin.

Lang. *lap. fig. Tab.* XXXV, *fig. ult.*

12. — *placenta.*

This is the name applied by Lamarck to the echinus which has been assumed above as the type of the genus *Arachnius.*

13. *S. parma.*—Orbicular; the back rather convex; with five subovate ambulacra, disjoined at the apices; and five ramified grooves in the lower part; the vent marginal. Recent.

14. — *subrotunda.*—Orbicular; the back rather convex; with five subovate ambulacra, contracted in their apices; the vent beneath the margin.

Leske ap. Klein, *Tab.* XLVII, *fig.* 7.

15. — *placunaria.*—Elliptical, depressed, and widest in the fore part; with narrow linear ambulacra, disjoined at their apices; the vent near to the margin. Recent. South Sea.

16. — *latissima.*—Very large, depressed, elliptical, subpentagonal, and truncated posteriorly; with oblongo-oval ambulacra; the vent near to the margin. Recent. South Sea.

17. — *ambigena.*—Ovato-elliptical; the back rather convex; the sides rather winding; the ambulacra ovato-oblong, pulvinated; the vent near to the margin.

Leske ap. Klein, *Tab.* XIX, *fig. C, D.*

An *Echinanthus?* This appears to approach nearly to the genus *Clypeaster.*

GENUS X. *Fibularia.*—Subglobular, ovoid, and nearly round, with no determinate margin; the ambulacra forming petaloidal~~, short~~, narrow, and circumscribed figures; the mouth beneath, central; the vent near to the mouth, or midway between it and the side. *Pl.* II, *fig.* 4, 5.

Synon. *Echinocyamus,* Phelsum and Leske.

The known species of this genus are of very small size.

Sp. 1. *Fib. nucleus cerasi.*—Circumference circular; upper surface globose; sides rather sulcated; the base narrow and flat in the middle; the small areas petal-formed and rather pulvinated; the vertex excentric with four pores; the mouth circular; the vent smaller than the mouth, and oblong.

2. *F. vertice centrali.*—This differs from the preceding only in the vertex being central.

3. — *ervum.*—Globose; the circumference inclining to oval; the base narrow; sides sulcated; and the ambulacra somewhat raised.

4. — *craniolaris.*—Anterior surface globose, the posterior subangular, pulvinated, and abrupt; the circumference elliptical; the vertex excentric; the base rather narrow.

The 5th, 6th, and 7th species of Phelsum, *turcica*, *vicia*, and *ovata*, appear to be merely varieties of the fourth species (*Craniolaris*). The 8th and 9th species, *lathyrus* and *equinus*, do not appear to be marked by any characters decidedly distinctive.

10. — *angulosa.*—Appears to be distinguishable from the circumference possessing somewhat of a quinquangular form.

11. — *ovalis.*—This, besides being of an obtusely oval form, is marked by four pores existing in the vertex.

12. — *inæqualis.*—Bearing the form of an apple-pip, or seed, ovate, very slightly pentagonal; the back uneven and anteriorly gibbous, posteriorly slanting and flattish; base subglobose and rather narrow; sides sulcated; petals sub-pulvinated; the apex central.

13. — *cor ranæ*, and Sp. 14. *F. paddehart.*—Appear to be varieties of the twelfth (*F. inæqualis*).

These small echini have been, it appears, found only recent in the Adriatic, and on some parts of the American coast.

14. — *ovulum.*—This is the least known of these echinidæ, being about the size of a pea; globosely ovate; the base rather narrow; ambulacra short, and separate at their terminations.

15. — *tarentina.*—Ovately elliptical; rather convex; plano-convex beneath; ambulacra short and disjoined.

Genus XI. *Echinoneus.*—Obovate or suborbicular, rather depressed, of a boat-like form; the ambulacra, formed by ten grooves, radiating from the vertex to the base.

These echini differ from those of the preceding genus by their extended ambulacra; they are also larger, and of a more oblong form.

Sp. 1. *Echinon. cyclostomus.*—Ovato-oblong, rather depressed, though pulvinated; five pores in the vertex; the mouth round. Recent.

Leske ap. Klein, *Tab.* XXXVII, *fig.* 3, 4.

2. — *semilunaris.*—Ovato-oblong, rather depressed; with four pores in the vertex; the mouth oblong, obliquely transverse. Recent.

Echin. minor, Leske ap. Klein, *Tab.* XLIX, *fig.* 8, 9.

3. — *gibbosus.*—Ovate, turgid, irregular; vertex excentrical; ambulacra waved; the mouth oval, acute, and obliquely transverse. Recent.

One species remains which is placed under this genus, but not without some hesitation. It is figured, by Scilla, *Tab.* XI, *fig.* 1, 2, and is named, by Phelsum, *Echinoneus scutiformis;* but its characters are such as to render it difficult to determine under what genus it should be placed.

It is placentiform, its circumference oval; the ambulacra striated, passing from the vertex nearly to the mouth, where they terminate in slightly depressed grooves; the mouth is in the middle of the base, obtusely pentagonal; the vent towards the margin.

The striated rays, with the grooves in the base, agree with *Clypeus;* the structure and disposition of its ambulacra with *Clypeaster;* whilst its outline and form, with the position of the mouth and vent, approximate it to *Scutella.*

No figure of this genus is given, since, to obtain an idea of its appearance, it is only necessary to connect its ovoidal boat-like form with the situation of the mouth and vent, as in the preceding genus, the ambulacra being continued from the vertex to the base.

Genus XII. *Ananchytes.*—Irregularly helmet-formed, ovate or conoidal; the ambulacra radiating from the vertex to the margin, and even to the mouth; the mouth labiated and subtransverse, near the margin, at one end; the vent at the opposite end.

The species of this genus are only known fossil.

Synon. *Cassis, Galea,* and *Galeola,* Klein. *Echinocorytes,* Leske.

Sp. 1. *An. ovata.*—Obovato-conoidal; the vent ovate.

Leske ap. Klein, *Tab.* LIII, *fig.* 3.

Fossil, near Paris.

2. — *striata.*—Ovato-rotund, raised, and much striated; the back convex, somewhat compressed, with numerous vertical striæ; the assulæ obsolete.

Leske ap. Klein, *Tab.* XLII, *fig.* 4.

Fossil, Picardy.

3. — *gibba.*—Ovate, raised; the back ventricose, but, at the top, compressed; the sides depressed inferiorly, with light ambulacral interstices; the vertex duplicate.

Leske ap. Klein, *Tab.* XV, *fig. A, B.*

Fossil, from Normandy.

4. — *pustulosa.*—Ovato-conical, pointed towards the top; depressed, and showing the assulæ at the sides; the biporous lines of the ambulacra disposed in pairs; the vertex double and impressed.

Leske ap. Klein, *Tab.* XVI, *fig. A, B.*

Fossil.

5. — *bicordata.*—Obovate; slightly grooved at each extremity; the back smooth, with a double vertex.

Spatangites bicordatus, Leske ap. Klein, *Tab.* XLVII, *fig.* 6.

Fossil, from Mons.

6. *A. carinata.*—Cordated, slightly grooved forwards; the back carinated in the middle.

Spatangites carinatus, Leske ap. Klein, *Tab.* LI, *fig.* 2, 3.

7. — *elliptica.*—Ovato-elliptical and pulvinated; with two remote vertices; assulæ nearly obsolete.

Knorr, *Petr. Tab.* E. III, *fig.* 6.

8. — *cordata.*—Cordato-conical; assulæ evident; dented in at the anterior part; the ambulacra in bands, with four rows of pores; the vertex not divided.

Spatangus ananchytis? Leske ap. Klein, *Tab.* LIII, *fig.* 1, 2.

Fossil.

9. — *spatangus.*—Cordated, convex; ambulacra impressed and continued to the mouth; a groove in the carinated posterior part.

Fossil, from France.

10. — *semiglobus.*—Ovato-hemispherical; base flat; ambulacra narrow, with ten biporous lines, approximated in pairs; the vertex undivided.

Echinocorytes minor. Leske ap. Klein, *Tab.* XVI, *fig.* C, D.

Fossil.

11. — *pillula.*—The least; ovato-globulose; rather convex beneath; vent in the upper part of the edge.

Fossil, from near Beauvais.

12. — *cor avium.*—Subcordated, convex; ambulacra widely striated; the fifth obsolete.

Spatangus ovatus, Leske ap. Klein, *Tab.* XLIX, *fig.* 12, 13.

Fossil.

GENUS XIII. *Spatangus.*—Gibbous, heart or egg-shaped; the mouth beneath, near to the wider end, transverse, labiated, and without teeth; the vent on the side, at the opposite end; the ambulacra, four or five, short and unequal.

The striking difference of form between the egg-shaped and heart-shaped species of this genus had almost induced Leske to divide these bodies into two genera, and to have considered the former as *Brissi*, and the latter as *Spatagi*; but further consideration, and the concurring opinion of Muller, as to the identity of the animals themselves, led him to retain them under one genus, separating them by divisions, chiefly founded on these characters, into the two families of *Brissus* and *Spatagus*. Lamarck has thought proper to effect this separation in a more simple manner; he divides the species into those which have four ambulacra, *Brissi*, and those which have five, *Spatangi*; the general form and characters of both of which are represented.

Brissus (Ovum-marinum), *Pl.* II, *fig.* 13; *Spatangus (Cor. marinum)*, *fig.* 11.

* With four ambulacra (*Brissi*).

Sp. 1. *Spatangus pectoralis.*—Ovato-elliptical, depressed, large; four ambulacra, with the interstices elegantly granulated; the assulæ elongated at the margin. Recent.

Seba. *Mus.* III, *Tab.* XIV, *fig.* 5, 6.

2. — *ventricosus.*—Ovate, inflated, obsoletely assulated; with four oblong canaliculated ambulacra; the larger tubercles placed in zig-zag. Recent.

Brissus ventricosus, Leske ap. Klein, *Tab.* XXVI, *fig. A. An. Scill. Corp. Marin. Tab.* IV, *fig.* 1, 2.

3. — *purpureus.*—Cordated; with four smooth lanceolate ambulacra, the larger tubercles placed in zig-zag. Recent and fossil.

Spatangus purpureus, Leske ap. Klein, *Tab.* XLIII, *fig.* 3-5; *Tab.* XLV, *fig.* 5.

Scill. *Corp. Marin. Tab.* II, No. I, *fig.* 1.

4. — *ovatus.* — Ovate; semicylindrical; depressed backwards, with four excavated canaliculated ambulacra, the fore ones oblique.

Spatangus brissus unicolor., Leske ap. Klein, *Tab.* XXVI, *fig. B, C.*

Recent.

5. S. *carinatus.*—Ovate, inflated, and a little turgid at the sides; ambulacra four, the fore ones transversely divaricated; the dorsal area carinated backwards, and obtusely projecting. Recent.

Spatangus brissus, late carinatus, Leske ap. Klein, *Tab.* XLVIII, *fig.* 4, 5.

6. — *columbaris.*—Oval; vertex depressed; with four shortish ambulacra, the hinder ones straight.

Recent. Seba, *Mus.* III, *Tab.* X, *fig.* 19.

7. — *compressus.*—Small, ovate, as if compressed at the sides, and not spotted; the back carinated; four impressed ambulacra.

Recent, from the Isle of France.

8. — *crux andreæ.*—Ovate, depressed; with four lanceolate ambulacra, obliquely divaricating; with ocellated interstices. Recent. South Sea.

9. — *sternalis.*—Ovate, assulated, spotted; with four ambulacra; with a carinated sternum on the lower surface. Recent. South Sea.

10. — *planulatus.*—Elliptical, depressed; with four narrow lanceolate ambulacra, obliquely divaricating; interstices subocellated. Recent. South Sea.

** With five ambulacra (*Spatangi*).

11. — *canaliferus.*—Cordato-oblong, gibbous in the hinder part; with five open impressed ambulacra, the foremost the deepest, and channel-formed.

Spatangus lacunosus, Leske ap. Klein, *Tab.* XXVII, *fig. A.*

Recent, in the Indian Sea. Fossil.

12. — *atropos.*

An spatangus lacunosus? Leske ap. Klein, *Tab.* X, *fig. A, B.*

Recent and fossil.

13. *S. arcuarius*.—Cordated, inflated, gibbous posteriorly; with five ambulacra, the side ones resembling double bows; the mouth subcentral.

Spatangus pusillus, Leske ap. Klein, *Tab.* XXIV, *fig.* c, *d*, *e*, and *Tab.* XXXVIII, *fig.* 5.

14. — *punctatus*.—Cordated, convex; the back carinated posteriorly, with small punctiform tubercles; the ambulacra crenulated.

An spatangus cor anguinum? Leske ap. Klein, *Tab.* XXIII*, *fig.* C.

Fossil.

15. — *cor anguinum*.—Cordate, subconvex; five impressed ambulacra, with four rows of pores; two rows of pores extended beyond the ambulacra. *Pl.* II, *fig.* 11.

Spatangus cor anguinum, Leske ap. Klein, *Tab.* XXIII, *fig.* *A*, *B*, *C*, *D*; *Tab.* XLV, *fig.* 12; and *Tab.* XXIII, *fig.* *e*, *f*.

16. — *retusus*.—Cordiform, raised in the hinder part of the back; convex, but depressed, narrower and grooved before; with five ambulacra, the fifth in the dorsal groove. Fossil.

Echino-spatagus, Breyn, *Tab.* V, *fig.* 3, 4. *Spatangus depressus*. Leske?

17. — *subglobosus*.—Cordato-orbiculate; convex on both sides; with five ambulacra, doubly biporous; the mouth reniform; the vent ovate.

Fossil. Leske ap. Klein, *Tab.* LIV, *fig.* 2, 3.

18. — *gibbus*.—Cordato-abbreviated; convex; subgibbous; depressed in the fore part; the hinder part raised; with five ambulacra, doubly biporous; the vent ovate.

Fossil. *Encyc. fig.* 4, 5, 6.

19. — *prunella*.—Subglobose; gibbous in the back part; five short ambulacra with four rows of pores; the

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* There exists a variety of this species, *Spat. cor. anguinum, sulcis crispis*, in which the ambulacra are slightly bent, and have their transverse striæ rather broader.

vent at the highest part of the marginal area.

Fossil, from Maestricht.

20. *S. radiatus*.—Ovate, raised, grooved before, and there rather depressed; five ambulacra, the fifth rather obsolete in the groove.

Fossil, from Maestricht.

Spatangus striato-radiatus, Leske ap. Klein, Tab. XXV.

No echinital remains appear to have been discovered in either the transition or the mountain limestone. They occur, but not frequently, in the lias formation; and, from the size and form of the spines, small and setose, they may be supposed to belong to some of the species of *Cidaris*, or of the Lamarckian genus, *Echinus*.

No remains of these animals are found in the sandy beds of the inferior oolite, which have been deposited over the lias; but, in the fuller's earth of the inferior oolite, placed over these, the *Cidaris subangularis* of Klein, and the *Echinus angulosus* of Lamarck, with one or two more of the Lamarckian genus *Echinus*, are found. Here are also first discovered remains of the genus *Clipeus: Clipeus sinuatus* of Plot, and *Clipeus clunicularis*, are here found in very good preservation. These fossils are afterwards found in all the succeeding superior beds of the oolite series.

Echinidal spines, of a long, acicular form, so well preserved as to retain traces of their original colour, are found in the Stonesfield slate.

In the cornbrash, and in the clay over the great oolite, are found a very depressed conular *Echinus*, which might, at first sight, be mistaken for *Cl. sinuatus*. The situation of the mouth and vent would characterise it as a depressed *Galerites*, but that the petaloidal forms in which its ambulacra are disposed would place it rather among the *Clypeasters*.

Several species of *Cidarites* also occur in the beds of the oolite, and principally in the cornbrash, in the clay over the great oolite, and in the upper beds of that rock. Three beautiful species are found chiefly in the coral rag:—1. *Cid. papillata*, *Org. Remains*, Vol. III, *Pl.* I, *fig.* 9, very closely agreeing with that which is found in the chalk. 2. *Cid. intermedia*, *Org. Remains*, Vol. III, *Pl.* I, *fig.* 6. 3. *Cid. diadema*, *fig.* 4 of the same plate. In this bed, probably the last in which they occur, none having been spoken of as found in any strata of posterior formation, *Clipeus sinuatus*, and *clunicularis*, are found in excellent preservation.

The green sand presents some very curious and interesting facts respecting these fossils. In the waters which deposited this formation, the *Spatangi* appear to have first existed; no remains of this genus having been discovered in any of the subjacent formations. It is also deserving of observation, that they are not found again but in the chalk, and in the seas of the present world. These, like almost all the fossils of the green sand, are siliceous, and are rendered more interesting from the white quartz crystals which fill their cavities, and from their excellent preservation, by which the minutest markings on their surfaces are shewn.

If the fossil, which has been so frequently considered as *Clipeus clunicularis*, be not ranged under *Galerites*, Lam. (*Conulus*), it is in this formation that *Galerites* first appears in a very small species.

Two of the genus *Cidarites* are found in the neighbourhood of Heytesbury, which have been figured, *Organic Remains*, Vol. III, *Pl.* I, *fig.* 12 and 13, and are remarkable for the appendages which are attached on the upper surface, round the superior opening, and which extend over nearly a third of the surface. In one of these, *fig.* 12, this appendage is formed of roundish plates, their margins having obtained somewhat of a polygonal form, apparently from the lateral pressure against each other from the increase of their size: a foramen is generally discoverable in the centre of each plate, and numerous short filaments connect them with each other. Repeated examination of this structure, in numerous specimens, has led to the suggestion, that this appendage may have been formed by the young animals, just escaped from their ovulæ, and thus attached to the surface of the parent. The fossil, represented *fig.* 13, is furnished with appendages formed by raised lines, crossing each other in an irregular trellissed form. No explanation has yet been offered which will account for the existence of this structure. May it not have proceeded from corrugations of the soft cuticular surface occasioned by the attachment of the young, as noticed in the preceding fossil?

The chalk marl does not appear to contain any fossil echinidæ whatever.

It is in the chalk, and chiefly, perhaps, in that with interspersed flints, that these fossils are most abundant. *Ananchytes*, Lam. (helmet-shaped), is found here only: no individual has been noticed as having been found in any of the preceding subjacent formations; nor are any found in the posterior formations, or among the echinidæ of the present seas. Specimens of the *Galerites*, Lam. frequently occur here; but, as has been observed respecting *Clypeus* and *Ananchytes*, this genus is only known in its mineralised remains.

The *Spatangites* are also frequently found in the chalk.

Numerous specimens of the genus *Cidarites* are also found in the chalk, and particularly in the Kentish chalk pits, where several different species are discovered, and not uncommonly those, which, from their being highly ornamented, may be termed *Diadems*, many of which have their tubercles perforated in the centre, and have also the bases of their papillary projections, on which the spines articulate, ornamented by regular crenulations.

Siliceous casts of the different species which exist in a mineralised state are frequently found in the gravel derived from the chalk; particularly of the smaller *Galeritæ*, and which, from their general diffusion, and from the irregular variation of their forms, not allowing their separation into distinct species, have been spoken of as *Echinitæ vulgares*.

Shells.—Recent shells are divided into univalves, bivalves, and multivalves; the univalves being also divided into those which have one or more chambers, being unilocular or multilocular. But another section is necessary for the reception of those extinct shells of the former world which have been found in the earlier strata, and which, though bearing the outward appearance of bivalve shells, are divided by septa into several chambers. Such are *Productus* of Sowerby, first noticed by Martin; and *Pentamerus* discovered by Mr. Aikin in the mountain limestone of Shropshire, the nature of which shell has been so successfully investigated by Mr. Sowerby *. These shells may be distinguished as multilocular bivalves.

Univalves vary considerably in their *forms*, being tubular, discoidal, fusiform, turbinated (the spire passing suddenly from the tumid belly of the shell), or turriculated (the turns gradually enlarging, so as to form an elongated cone); they are also ovoid, elliptical, &c. The surface also varies considerably, being smooth, striated, trellised, grooved, &c., and is, in some shells, beset with rounded or sharp ribs, spines, foliaceous processes, &c. The shell *(Pl. IX, fig. 2)* terminates superiorly with the *top of the spire*, which is pointed, obtuse, or globular, and sometimes decollated, as is chiefly observable in some shells of the genus *Bulimus*. The *spire (a)* is formed by the union of the *turns*, or *whirls (b)*, which are counted by reckoning the lower turn, containing the opening to where the left lip is attached, as one, and reckoning on the same line to the top of the spire. The turns generally go in a direction from the right to the left; they very rarely pass in the opposite direction, and, when that is the case, they are termed *reversed* shells. The line at which the whirls are united to each other is termed the *suture*. The whirls are either plain, keeled, grooved, crenulated, or crowned with points, tubercles, or spines, &c.

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* Mineral Conchology, Vol. I, p. 154, &c.

The *back (c)* is the external tumid part of the last turn which forms the opening; the *belly (d)* is the corresponding concavity, reaching to the part where the cavity contracts, which is called the *throat*. The *opening (e)* is circular, semicircular, oval, angular, &c., and is whole, or terminates in a groove or a notch, which is either straight or reverted: when the opening is longer than wide, it is said to be *longitudinal;* when wider than long, *transverse;* and when straight and narrow, *linear*. The *edge*, or *margin of the opening*, is divided into the *right and left lips:* the *right*, or *outer lip (f)*, reaches from that point where it rests on the last turn but one of the spire to the base of the shell. This lip is notched at its base in the buccinums, and channelled or grooved in the murexes, and has a fissure or notch in its side in pleurotomas. In several shells, as in the helixes, it extends over to the left side; in some shells the right lip is *eared*, having an appendix, differing in different species; being straight, smooth, digitated, &c. The *left lip (g)* is opposite, of course, to the right, being that part which is attached to the second turn of the spire, and is but of small extent in those shells the opening of which is entire. The *colu-*

mella (h), the substance round which the turns are formed, is on the left side of the shell, and terminates at its base; sometimes in a point, and sometimes in a hollow, which is termed an *umbilicus:* the surface of the columella varies considerably in different genera, being smooth or flat, or rounded, and sometimes plaited, transversely or obliquely; and sometimes dentated, channelled, tuberculated, &c.: in some instances the umbilical termination is filled, as if by an exudation of callus. The opening is sometimes filled by a testaceous or, sometimes, a cartilaginous body of a convex external surface, but flat on the side next the animal, where it is marked with a spiral line; this is termed the *operculum.*

Bivalve shells, when their valves are similar in size and form, are said to be *equivalved,* if not, *inequivalved;* when the anterior part agrees in form and size with the posterior, they are said to be *equilateral,* if not, *inequilateral.* The valves are connected at their base by a *ligament,* with or without a hinge, this ligament being placed either externally or internally: the *belly, Pl.* IX, *fig.* 8 (*a*), is the most tumid part; the *disk* (*b*) is that part between the belly and the *margin* (*c*), which is considered to refer to the *external* side, or, as it may be termed, when the shell is placed on its base, the *upper* side; then the *eminences,* umbones *(d),* are beneath the hinge, and terminate in the *points* or *beaks* (mucrones) (*e*), which are incurved, reflexed, earformed, &c. The beaks are frequently, in particular shells, accompanied by two external impressions; one of these, the *corselet (f),* is on the anterior surface, and is separated from the disk, generally, by a ridge, an angle, or a sunken line, and is often distinguishable by its difference of colour as well as by other circumstances: it is sometimes spinous, carinated, lamellated, &c., but it is generally smooth when it is said to be naked. The other, the *lunule (g),* is placed at the bottom of the posterior surface: it is variously shaped, oval, oblong, lanceolated, &c., and is sometimes edged, toothed, &c. The shell being placed on the hinge, the anterior side being forward, that is considered as the right valve which answers to the left hand, and that as the left valve which answers to the right hand of the observer. The length of the shell is measured from the hinge to the outer or upper edge, and the width from the end of the anterior to that of the posterior margin. Those shells, whose length exceeds their width, are considered as *longitudinal* shells, and those, whose width exceeds their length, *transverse* shells. The forms and markings of bivalves are too numerous to be noticed in this place. Shells are necessarily distinguished into *free,* such as are capable of being moved; and *fixed,* being such as become *adherent* to other solid bodies. On the internal surface of the valves are impressions of a regular form, varying in that respect as well as in their number, in different shells: these are the places where the animal was attached to the shell by its tendinous attachment, and may be called the *muscular impressions.* These vary in their number, according to the number of muscles employed for this purpose, being one, two, or even more, on each valve. The *hinge* (*h*) is placed in the most solid part of the shell, generally in its base, beneath its beaks. It is usually formed of teeth, which either shut into each other or into the opposite valve. Those teeth which are most decidedly beneath the beaks, in the middle, are termed the *cardinal* or *hinge teeth,* and the distant ones the *lateral* or *accessory teeth.* In some shells there are no decided teeth; the motion being regulated by the ligament being attached to a testaceous protuberance, termed a *callus.* The teeth themselves vary also in their forms, situations, &c., as will be seen in the description of the several genera.

A knowledge of the action of the ligament, which, it has been mentioned, serves to attach the valves, is necessary to be possessed by those who enter into the investigations frequently demanded respecting fossil bivalves. This ligament is sometimes placed externally, and sometimes internally. When external, it necessarily becomes stretched when the shell is closed; and then, if the muscle which holds the valves together becomes relaxed, it opens them by its elasticity only: but, if internal, between the valves, it becomes compressed when the valves are closed, and then opens them by its elasticity, as soon as the muscular action diminishes or ceases.

Multivalve shells differ materially in their form and structure: some, as the pholas, may be considered, from their having their two sides of the same form and dimensions, as *equivalved;* others, as the anomia, are *inequivalved.* Some have their valves joined by a squamose kind of suture, as the balanus; others have their valves united in a tendinous peduncle; whilst, in others, the valves are contained in a testaceous tube.

The illustrious Linnæus disposed all the shells which were known in his time under thirty-six genera, founding their generic distinctions, in the univalves, chiefly on the characters of their openings, and, in the bivalves, on those of their hinge. But these genera were found insufficient for the necessary distinctions: shells essentially different being crowded together under the same genus; and the fossil shells which were subsequently discovered differed so much from those which were before known, as to render an addition to the number of the genera absolutely necessary. This work was commenced by M. Bruguiere; and has been since most successfully conducted by Le Chev. de Lamarck, to whom we are much indebted for making the required augmentation of the number of genera, and for suggesting several other important changes in the classification.

In this part of the present work it is proposed to give the most prominent characters of the known genera, with sketches illustrative of their distinctive differences.

Univalves.

Genus 1.—*Planospirites.*—A flat univalve, nearly circular, with a cord-like ridge passing from the edge on to the inferior surface, and curving backwards in a spiral direction. Fossil, St. Peter's, Maestricht, *Pl.* III, *fig.* 1.

2. *Oscana.*—An oval univalve, slightly vaulted; no spire, semitransparent, and nearly coriaceous. Recent. *Pl.* III, *fig.* 2.

3. *Testacella.*—An obliquely conical univalve; apex turned; opening oval; the left edge turned inwards. Recent. *Pl.* III, *fig.* 3.

Grows on the caudal termination of an animal generally resembling a slug.

4. *Patella.*—A shield-formed, subconical univalve; no spire, and without perforation of the disk, or marginal fissure[*]. Recent and fossil. *Pl.* III, *fig.* 4.

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[*] *Patella mitrata*, Lin. and *P. cornucopia* and *dilatata*, Lam. have the peculiar property of being attached to an operculum, or undervalve, by a muscle, the mark of attachment of which, especially on the lower valve, bears somewhat of the figure of a horse-shoe; this valve being attached by the other side to other bodies.

This shell, which has been named *Hipponix*, is considered by M. de France, its discoverer, as an univalve, the animal of which has the power of forming this additional portion to raise it above the substance by which it is supported.

Mr. G. Sowerby, who has given a very interesting account of this shell in his valuable work on the genera of recent and fossil shells, considers it as being decidedly a bivalve shell.

It has not either cardinal ligament or hinge; and it is worthy of remark, similar muscular impressions are observable on other valves which have been attributed to other species of *Patella*.

5. *Fissurella.*—A shield-formed, subconical univalve; no spire; the vertex perforated with an oblong opening. Recent and fossil. *Pl.* III, *fig.* 5.

6. *Emarginula.*—An obliquely conical univalve; the vertex inclined, and the posterior margin notched. Recent and fossil. *Pl.* III, *fig.* 6.

7. *Concholepas.*—An oval univalve, convex upwards; the vertex inclined on the left side; the cavity plain, terminating at the base of the right edge with two teeth and a groove. Recent. *Pl.* III, *fig.* 7.

8. *Stomatia.*—An oval, earformed univalve, with a prominent spire; opening ample, entire, and longer than wide; disk not perforated. Recent. *Pl.* III, *fig.* 8.

9. *Argonauta.* — An involuted univalve; the spire turning into the opening; very thin, with a tubercular double dorsal keel. Recent, and very rarely fossil. *Pl.* III, *fig.* 9.

10. *Carinaria.*—A subconical univalve; flattened at the sides, very thin; the apex turned in a small spiral; the back furnished with a dentated keel; the opening entire, oblong, and contracted toward the keel. Recent. *Pl.* III, *fig.* 10.

11. *Sigaretus.*—An oval, flattish, and earformed univalve, with a short spiral columella; the opening entire, ample, longer than wide, and spread out towards the right lip. Recent, and but rarely fossil. *Pl.* III, *fig.* 11.

12. *Haliotis.*—An oval, flattish, and earformed univalve, with a depressed spire and row of round holes along the right edge; the opening large, and longer than wide. Recent. *Pl.* III, *fig.* 12.

13. *Calyptræa.*—A conoidal and spiral univalve; the apex entire, and rather depressed; with a folded tongue-like process proceeding from the internal summit. Recent and fossil. *Pl.* III, *fig.* 13.

14. *Infundibulum.*—A conical univalve; hollow beneath, spirally twisted, with a central spiral columella, and a spirally decurrent plate or valve within; mouth round, expanded; lip entire and sharp. Recent and fossil. *Pl.* III, *fig.* 14.

I have adopted Mr. Sowerby's description of this genus, agreeing with that gentleman in the propriety of separating this shell from the genus *Calyptræa,* as has been done by M. Denys de Montfort.

15. *Crepidula.*—An oblong, vaulted univalve; the apex inclined to the edge; the cavity partially divided by a simple diaphragm. Recent, and very rarely fossil. *Pl.* III, *fig.* 15.

16. *Dentalium.*—A tubular, tapering, slightly bowed univalve; open at both ends*. Recent and fossil. *Pl.* III, *fig.* 16.

17. *Siliquaria.*—A tubular univalve, spiral at the beginning, and continued in an irregular tubular form; partially divided at the side by a narrow sharply dentated slit, and sometimes formed into chambers by partial septa. Fossil. *Pl.* III, *fig.* 17.

The commencing spiral turn is omitted in the figure, to give a better opportunity of showing the peculiar characteristic of the shell, its dentelated fissure.

18. *Vermicularia.*—A tubular, free univalve, commencing spirally, and continued more or less contorted; the sides entire, and the opening simple and round. Recent and fossil. *Pl.* III, *fig.* 18.

The spiral commencement of *Vermicularia* is not marked in the figure, it having been more desirable to show the form in which this shell is generally found as a fossil. Indeed, they occur so frequently in this form, as to give reason for supposing either that the straight *Vermicularia* forms a distinct species, or that, the spiral commencement being assumed as a generic distinction, another genus should be formed for the reception of the straight ones. Perhaps some of the smaller fossil vermicular shells, resembling those in the preceding figure, may be found to belong rather to *Vermilia*, Lam.

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* *Dentalium, Siliquaria, Vermicularia,* and *Serpula,* belong to *Les Annelides Sedentaires.* Lam.

19. *Serpula.*—A tubular, adherent univalve, variously twisted and grouped; sometimes divided by entire septa. Recent and fossil. *Pl.* III, *fig.* 19.

The protean character of the fossil shells of this genus is very remarkable, they imitating the forms of the shells of several other genera.

20. *Conus.*—A turbinated, convoluted, and reversedly conical univalve; the aperture long, narrow, toothless, and not contracted at its base. Recent and fossil. *Pl.* III, *fig.* 22.

21. *Cypræa.*—An ovate and vaulted univalve; spire small, and nearly covered over; the opening narrow, the length of the shell; the margins involuted and toothed on each side. Recent and fossil. *Pl.* III, *fig.* 23.

22. *Ovula.*—An obovate univalve, tumid in the middle, and more or less elongated; the opening, the length of the shell, with a channel at each end; with no teeth on the left side. Recent. *Pl.* III, *fig.* 24.

23. *Bulla.*—A univalve of a roundish oval form, the spire not projecting; the opening the length of the shell, and widest at the lower part. Recent and fossil. *Pl.* III, *fig.* 25.

24. *Terebellum.*—A spiral and convoluted univalve, with a pointed apex; the opening long and narrow upwards, toothless, and notched at the base. Recent and fossil. *Pl.* III, *fig.* 26.

M. de Montfort has separated a shell which had been included in the genus *Terebellum*, and has formed of it the following genus, since adopted by Mr. Sowerby.

25. *Seraphs.*—A convoluted, elongated, univalved

shell; spire internal, concealed; base truncated; mouth longitudinal, extending to the apex of the spire; lip sharp; columella smooth. It differs from *Terebellum* chiefly in having its spire entirely internal.

26. *Volvaria.*—A cylindrical and convoluted univalve; the spire scarcely extruded; the opening narrow, the length of the shell; the columella plaited at its base. Recent. *Pl.* IV, *fig.* 1.

27. *Oliva.*—A spiral and nearly cylindrical univalve, notched at the base; the turns of the spire separated by a small groove; the columella obliquely plaited. Recent and fossil. *Pl.* IV, *fig.* 2.

28. *Ancilla.*—An oblong, subcylindrical univalve, with a short spire; the sutures not grooved; the aperture spread; the base notched; a thick oblique fold at the base of the columella. Recent and fossil. *Pl.* IV, *fig.* 3.

29. *Voluta.*—A subfusiform, more or less tumid, univalve; apex obtuse or papillated; base slightly grooved, not channelled; columella plaited, the lower plaits being the largest or the longest. Recent and fossil. *Pl.* IV, *fig.* 4.

30. *Mitra.*—A subfusiform univalve, with a pointed apex; base notched, but with no channel; the columella plaited, the lower plaits being the smallest. Recent and fossil. *Pl.* IV, *fig.* 5.

31. *Columbella.*—An oval univalve, with a short spire; the base grooved, but not channelled; the lip crenulated, and tumid on the inner side; folds or teeth on the columella. Recent. *Pl.* IV, *fig.* 6.

32. *Marginella.*—An oval univalve, with a short spire; lip with a thick border; base slightly grooved; columella plaited. Recent and fossil. *Pl.* IV, *fig.* 7.

33. *Cancellaria.*—An oval and subturretted univalve; lip transversely grooved on the inside; base slightly

notched, sometimes entire; columella with sharp but compressed plaits. Recent and fossil. *Pl.* IV, *fig.* 8.

34. *Fasciolaria.*—A subfusiform univalve; the base grooved; no projecting sutures; columella with two or three very oblique folds. Recent. *Pl.* IV, *fig.* 9.

35. *Turbinellus.*—A subfusiform univalve; the base grooved; with from three to five compressed transverse plaits on the upper part of the columella. Recent. *Pl.* IV, *fig.* 10.

36. *Buccinum.*—A suboval univalve; opening oblong, notched at the base, but not channelled; columella convex and full. Recent and fossil. *Pl.* IV, *fig.* 11.

37. *Eburna.* —A suboval univalve; the lip thick; opening oblong and grooved at the bottom; the columella umbilicated and slightly grooved at its base. Recent and fossil. *Pl.* IV, *fig.* 12.

38. *Terebra.*—A longish turriculated univalve; the opening about one-third of its length, notched at its base; columella terminating obliquely. Recent and fossil. *Pl.* IV, *fig.* 13.

39. *Dolium.*—A ventricose, nearly globose univalve; ribbed transversely; the lip ribbed through its whole length; the opening wide, notched at the bottom. Recent. *Pl.* IV, *fig.* 14.

40. *Harpa.*—An oval and ventricose univalve, with longitudinal compressed ribs terminating upwards in an angle or point; the opening terminating in a notch; the columella smooth, with an acute base. Recent and fossil. *Pl.* IV, *fig.* 15.

41. *Cassis.* — A ventricose univalve; the aperture long, terminating in a short reflected groove; the lips subdentated: the left lip flattened, and forming a ridge on the body of the shell; the columella plaited on its lower part. Recent and fossil. *Pl.* IV, *fig.* 16.

42. *Nassa.*—An oval univalve; the opening terminating inferiorly by an oblique reflected notch; a callosity on the left side covers the columella, forms into a transverse fold in the upper part, and has its base obliquely truncated. Recent. *Pl.* IV, *fig.* 17.

43. *Purpura.*—An oval and sometimes tuberculated or spinous univalve; the opening terminating in a short oblique groove, notched at the extremity. The columella naked, flat in the whole of the lower part, and finishing at its base in a point. Recent and fossil. *Pl.* IV, *fig.* 18.

44. *Strombus.*—A slightly ventricose univalve, terminating inferiorly by a short truncated or notched groove; the right edge dilating with age into a wing or lobe, having a sinus distinct from the notched canal at the base. Recent and fossil. *Pl.* IV, *fig.* 19.

45. *Pterocera.*—A ventricose univalve, terminating inferiorly by an elongated canal; the right edge dilating with age into a digitated wing, with a sinus at its summit. Recent. *Pl.* IV, *fig.* 20.

46. *Rostellaria.*—A subturriculated or fusiform univalve, terminating at its base with a lengthened canal, with a sharp beak; the lip, dilating with age, is either whole or dentated, with a groove at the lower end, and a sinus extending to the summit of the spire. Recent and fossil. *Pl.* IV, *fig.* 21.

47. *Murex.*—An ovate or oblong univalve, with rough, spinous, or fringed longitudinal sutures; base channelled. Recent and fossil. *Pl.* IV, *fig.* 22.

48. *Fusus.*—A subfusiform univalve; ventricose in the middle or lower part, but with no varices; the spine longish; the base channelled; columella generally smooth; and lip entire. Recent and fossil. *Pl.* IV, *fig.* 23.

49. *Pyrula.*—A somewhat pyriform univalve, with-

out varices; the spire short; the base channelled and caudated; the columella smooth, and the lip entire. Recent and fossil. *Pl.* IV, *fig.* 24.

50. *Pleurotoma.*—A turriculated and subfusiform univalve; the lower part of the opening channelled; a notch in the upper part of the right lip. Recent and fossil. *Pl.* IV, *fig.* 25.

51. *Clavatula.*—A subturriculated univalve, the opening terminating by a short channel or notch; a sinus in the upper part of the right lip. Recent. *Pl.* IV, *fig.* 26.

52. *Cerithium.*—A turriculated univalve, the opening oblique, terminating at the base by a truncated or recurved canal, and upwards in a groove more or less distinct. Recent and fossil. *Pl.* IV, *fig.* 27.

53. *Melania.*—A turriculated univalve, the opening oval or oblong; the inner lip spread out at the base of the columella, which is smooth. Recent and fossil. *Pl.* V, *fig.* 1.

54. *Turritella.*—A turriculated univalve; the opening roundish; the margin disjoined in the upper part; a sinus in the right lip. Recent and fossil. *Pl.* V, *fig.* 2.

55. *Pyramidella.*—A turriculated univalve; the opening entire and semi-oval; the columella projecting, furnished with three transverse plaits, and perforated at its base. Recent. *Pl.* V, *fig.* 3.

56. *Auricula.*—An oval or oblong univalve, with a raised spire; the aperture oblong, entire, and contracted above; the lips united; the columella with plaits independent of the decurrence of the outer lip. Recent and fossil. *Pl.* V, *fig.* 4.

57. *Achatina.*—An oval or oblong univalve; the opening oblong and entire; the columella smooth. Recent. *Pl.* V, *fig.* 5.

58. *Lymnæa.*—An oblong, subturriculated univalve; the opening entire and oblong; the right lip rising within the opening, and forming an oblique fold on the columella. Recent and fossil. *Pl.* V, *fig.* 6.

59. *Turbo.*—A conoidal and subturriculated univalve; the opening roundish; the columella smooth; the margin disjoined at the upper part. Recent and fossil. *Pl.* V, *fig.* 7.

60. *Monodonta.*—An oval or conoidal univalve; the opening roundish and entire; the columella forming a tooth-like process by its projecting base; the margin disjoined at the upper part. Recent. *Pl.* V, *fig.* 8.

61. *Bulimus.*—An ovate or oblong, and subturriculated univalve; the opening entire, longitudinally oblong, having, in adults, a reflected right lip; the columella smooth, neither truncated nor expanded at its base. Recent and fossil. *Pl.* V, *fig.* 9.

62. *Phasianella.*—An ovate and thick univalve; the opening longitudinal, ovate, and entire; with a sharp plain lip; the columella smooth and attenuated at its base. Recent and rarely fossil. *Pl.* V, *fig.* 10.

63. *Vivipara.*—An oval or oblong univalve, with a regularly elevated and rounded spire; the opening entire, longitudinal, and oblong; the lips united angularly above. Recent and fossil. *Pl.* V, *fig.* 11.

64. *Helix.*—A globose univalve, with a convex or conoidal spire; the opening entire, wider than long, and diminished in its upper part by the projection of the penultimate turn of the spire. Recent and fossil. *Pl.* V, *fig.* 12.

65. *Helicina.*—A subglobose univalve; the opening entire and semiovate; the columella callous, with no umbilicus; depressed and flattened at the lower part. Recent; one or two fossil species? *Pl.* V, *fig.* 13.

66. *Ampullaria.*—A subglobose univalve; the opening longer than wide, and entire; umbilicus at the base of the columella, but no thickening of the left lip. Recent and fossil. *Pl.* V, *fig.* 14.

67. *Natica.* — A subglobose, umbilicated univalve; opening semicircular and entire; the columella transverse, without teeth, and callous externally, the callus contracting or even covering the umbilicus. Recent and fossil. *Pl.* V, *fig.* 15.

68. *Nerita.*—A semiglobose univalve; the columella nearly transverse and flat, with an acute and generally dentated edge. Recent and fossil. *Pl.* V, *fig.* 16.

69. *Cyclostoma.* — A subdiscoidal or subpyramidal univalve, with round turns, the last of which is the largest; the opening round, or nearly so; the edge circularly united, forming a wide continuous margin. Recent and fossil. *Pl.* V, *fig.* 17.

70. *Pupa.*—A somewhat cylindriform univalve; the spire long, the last turn not being larger than the preceding one; the opening irregular, rounded or oval; the edges circularly united. Recent. *Pl.* III, *fig.* 20.

71. *Scalaria.* — A turriculated univalve; the turns rounded and nearly separate, with acute and longitudinal, raised ribs; the opening nearly circular; the margin uninterrupted and reflected. Recent and fossil. *Pl.* V, *fig.* 18.

72. *Delphinula.*—A subdiscoidal, thick, pearly, and umbilicated univalve; the turns generally muricated; the opening round; the margin circular and uninterrupted. Recent and fossil. *Pl.* V, *fig.* 19.

73. *Cirrus.*—A spiral and conical univalve, without a columella; funnel-shaped beneath; volutions united. Fossil. *Pl.* V, *fig.* 20.

74. *Planorbis.*—A discoidal univalve; spire depressed; turns visible on both sides; opening entire, but di-

minished by the projection into it of the preceding whirl. Recent and fossil. *Pl.* V, *fig.* 21.

75. *Euomphalus.*—An involute and compressed univalve; the spire depressed; concave beneath, or largely umbilicated; aperture mostly angular. Fossil. *Pl.* V, *fig.* 22.

76. *Janthina.*—A subglobose univalve; the opening triangular, with an angular sinus on the right edge. Recent. *Pl.* V, *fig.* 23.

77. *Trochus.*—A conical univalve; the opening almost quadrangular, transversely depressed; the axis oblique on the plane of the base. *Pl.* V, *fig.* 24.

78. *Solarium.*—A conical univalve, with an open umbilicus underneath; the inner edges of the whirls crenulated; the opening nearly quadrangular. Recent and fossil. *Pl.* V, *fig.* 25.

Multilocular Univalves.

M. Denys de Montfort, author of an interesting and important work, *Conchyliologie Systematique,* has, with much careful discrimination, separated into different genera the multilocular univalves; the microscopic shells into sixty; and those which are within the power of the naked eye, being those which had been included in *Nautilus, Ammonites, Belemnites, Orthoceratites, Spirula, Scaphites, Nummulites,* and *Siderolites,* into forty genera; forming almost every shell, marked by a slight difference, into a distinct genus. These separations, although, perhaps, founded on accurate discrimination, appear to be too frequent; and their multiplicity bears too much on the memory, and deprives it of the aid which it seeks to derive from classification. These observations are applicable only, perhaps, to the larger kinds; for, as to the microscopic shells, the eccentricity of their forms, their vast variety, and the peculiarity of character which mark their ornaments, must render their classification a very difficult task; every different shell appearing to repel all association. A more intimate knowledge of their nature and characteristics seems to be necessary before an appropriate arrangement of them can be adopted. The larger tribe has been separated into twenty-two genera, all of which have been found in a fossil state: whilst one genus only, *Nautilus,* is known to exist in a recent state. Two opinions are entertained respecting this great disproportion between the number of fossil and of recent shells of this tribe. Some suppose that those genera, of which only fossil shells are found, have become extinct; whilst others believe that these shells are still existing in a recent state; but are pelagian shells, their inhabitants constantly residing at the bottom of the deep. This opinion is entertained by some of the latest French writers, particularly by Mons. de Montfort.

But an examination of these shells proves, that, so far from their inhabitants having been destined to a constant residence at the bottom of the ocean, they possessed, beyond all other testaceous animals, the power of rising up to, and remaining at, the surface of the sea. Supposing them still to live, they would occasionally, as the *Nautilus* is, be seen at the surface; but not a single instance being known of a shell of these genera having been thus seen, their existence may be reasonably doubted.

The apparatus enabling the animal to raise or sink himself at pleasure is plainly discoverable in the fossil shell of the *Nautilus:* but the most important part of this organ, the continuous siphuncle, is not discoverable in the dried specimens of the recent shell. The shell in the *Nautilus (Pl.* VI, *fig.* 1*)* is formed of a number, more or less, of chambers, divided by pierced septa, The animal resides in the largest and last formed chamber; an elastic tube, proceeding from the animal, passes through the pierced septa and the several chambers, and terminates in the first. Now, assuming that the office of this tube is analogous with that of the swimming bladder of fishes, it is by no means difficult to conceive how the required changes of situation may be produced. The weight of the shell is so counterbalanced by the empty chambers, that the siphuncle passing through these chambers, accordingly as it is dilated with gaseous or with aqueous fluids, will alter the specific gravity of the whole mass, and cause it either to swim or to sink. Supposing the animal to be lying at the bottom of the sea, saturated with food, and the siphuncle filled with a fluid; as the food is digested and decomposed, detached gas may pass into the siphuncle, and gradually take the place of the water; when, in proportion as the specific gravity of the whole mass is thus diminished, it will rise, probably into that region of the waters in which the food of the animal most abounds. Here, on obtaining sufficient food, or on alarm from an enemy, the animal admits water into the siphuncle, and immediately sinks.

In all the other genera of this tribe, an apparatus, formed of vacant chambers and a membranous siphuncle, exists, capable of producing similar effects with those produced by that of the *Nautilus;* but necessarily differing in some respects, from variety of modification of the form and structure peculiar to each genus. The siphuncle is often very well displayed in sections of the *Orthoceratite,* and in these this tube will be found to have been capable of being dilated to a very considerable extent.

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Multilocular Spiral and Discoidal Shells.

GENUS 1. *Nautilus.*—A multilocular, spiral, and subdiscoidal shell; the turns contiguous, the outer one including the others; the chambers separated by *plain* or *nearly plain* transverse septa, concave outwards, and perforated by shelly tubes connected by a tubular membrane so as to form a complete siphuncle. Recent and fossil. *Pl.* VI, *fig.* 1.

2. *Orbulites.*—A multilocular, spiral, and subdiscoidal shell; the turns contiguous, the outer one including the others; the chambers separated by *winding* septa, pierced by a siphuncle at the outer side of their margin. Fossil.

The shells of this genus agreeing in their external form with that of the shells of the preceding genus, *Nautilus*, the difference being internal, from the septa being winding, and the siphuncle marginal, an illustrative figure was unnecessary.

The propriety of the adoption of this genus seems to be indisputable, its shells possessing the external characters of *Nautilus*, and the internal characters, the winding septa and marginal siphuncle, of *Ammonites.* But there are other fossil shells, which, possessing the exterior of *Nautilus*, have only one of the characteristics of *Ammonites*, as in *Organic Remains*, *Pl.* VII, *fig.* 15, in which the winding septa are without the marginal siphuncle; and in *fig.* 16 of the same plate, where the marginal siphuncle exists without the winding septa. Indeed, the situation of the siphuncle is too variable, existing in every point on a line from the centre, and, perhaps, from the posterior to the anterior margin, to allow of its being assumed alone as a distinctive generic character.

3. *Planulites.*—A multilocular, spiral, flattish, and discoidal shell; the turns contiguous and apparent; the

chambers separated by plain septa pierced with a marginal siphuncle. Fossil.

As the shells of the preceding genus have possessed the outer appearance of *Nautilus*, with the internal characters of *Ammonites*, so this shell possesses the external appearance of *Ammonites*, and, at the same time, is characterised by the plain concave septa of *Nautilus*. As its external form agrees with that of the following genus, another figure is not requisite.

4. *Ammonites.*—A multilocular, spiral, and discoidal shell, with contiguous apparent turns; the chambers divided by winding septa, pierced by a siphunculus always placed at the outer side. Fossil. *Pl.* VI, *fig.* 2.

Two very different shells have been placed under the genus *Ellipsolithes* (Sowerby), both oval and discoidal shells; but one possessing the involved whirls and the plain septa of *Nautilus*, and the other the whirls, apparent on both sides, and the winding septa of *Ammonites*. It being desirable that the student should be apprised of the forms and characters of these fossils, their figures and a description of their characters are given; but although, for the sake of discrimination, a name is added to each, it is not intended to urge a claim for their being considered as distinct genera. In this I am glad to concur with Mr. Sowerby, who observes, that "The genus *Ellipsolithes* must certainly be abolished, and its species ranged under *Ammonites*, the oval form being quite accidental."

5. *Nautellipsites.*—A multilocular, tumidly discoidal and elliptically spiral shell; the turns contiguous, the outer one including the others; situation of the siphuncle nearly central. Fossil. *Pl.* VI, *fig.* 3.

6. *Ammonellipsites.*—A multilocular, flatly discoidal and elliptically spiral shell; the turns contiguous and apparent on both sides; the chambers separated by

winding septa; the siphuncle marginal. Fossil. *Pl.* VI, *fig.* 4.

7. *Nummulites.*—A multilocular, lenticular shell; the spire internal, formed of several plates, connected with each other on both sides by numerous transverse septa, the internal plates being involved by the more external. Fossil. *Pl.* VI, *fig.* 5.

8. *Siderolites.*—A flattish shell, convex above and beneath, set with pointed tubercles, with four or five short unequal rays on the edge, not manifesting any real pores.

An idea of this fossil may be formed by considering the radiating appendices as proceeding from bodies like the *Nummulites.* Faujas St. Fond, who has given the best representation of these bodies, delineates them as being multilocular, somewhat like the *Nummulites.*

9. *Scaphites.*—A multilocular shell, commencing with spiral turns, the last of which, after being enlarged and elongated, is contracted and reflected. Fossil. *Pl.* VI, *fig.* 6.

10. *Spirula.*—A multilocular shell, partly spiral and partly straight; the whirls circular, separate from each other, and the last elongated in a straight line. The septa plain, concave outwards, and pierced, nearly at the margin, with a shelly tube. Recent and fossil. *Pl.* VI, *fig.* 7.

11. *Lituites.*—A multilocular shell, partly spiral and partly straight; the whirls circular and contiguous, but the last elongated in a straight line; the septa transverse, concave outwards, and pierced, nearly at their outer margin, with a siphunculus.

The figure of the preceding genus will suffice for this, only with the conceived difference of the whirls being contiguous, and a greater length of the straight part. The student should be guarded in his conclusions with respect to the contiguity of the whirls in these fossils. The contact is, necessarily, only in a line passing horizontally through the middle of the spiral; and as these fossils are constantly imbedded, this line of contact can only be seen when the artist is so successful as to make his section exactly in this line: if the section is made the least too high or too low, the whirls will not be seen in contact, but will appear separate, in proportion as the section is distant from the centre.

12. *Hamites.*—A multilocular hook-formed shell, with sinuous septa, pierced with a marginal siphuncle. *Pl.* VI, *fig.* 8.

13. *Orthoceratites.* — A multilocular straight, or slightly bent, cylindrical, or slightly conical shell; the chambers separated by plain septa, concave towards the larger end, and pierced with a siphunculus. *Pl.* VI, *fig.* 9.

14. *Baculites.*—A multilocular straight, or slightly bent, cylindrical, or slightly conical, shell; the chambers separated by sinuous septa, pierced with a marginal siphunculus. *Pl.* VI, *fig.* 10.

15. *Belemnites.*—A conical or fusiform stone, of brown radiating spar, generally terminating at the small end in a point, and having at the larger end a conical cavity, naturally retaining a conical testaceous body, divided into chambers by plain concave septa, and pierced by a siphunculus. *Pl.* VI, *fig.* 11.

16. *Hippurites.*—A straight or conical shell, furnished internally with transverse septa, and with two lateral, longitudinal, obtuse, and converging ridges. *Pl.* VI, *fig.* 12.

It was endeavoured to show, in a former work, that the spathose substance in the *Belemnite* was originally a light substance, of a texture somewhat similar to cork, and was the float to the animal, which rendered it so nearly equal to the weight of water as to allow it to rise or fall, as the siphuncle was filled with air or with water.

In the fossil last described a peculiar modification of structure in its covering appears to have accomplished the same purpose: the shelly enclosure has evidently been of a peculiar light texture, by which such a diminution of the gravity of the mass would be obtained as would fit it for being similarly acted upon by the internal presence of gas or of water, as in the instance of the *Belemnite*.

17. *Turrilites.*—A spiral, turriculated, multilocular shell; the turns contiguous, and all visible; the chambers separated by winding septa; with a siphuncle in their disks; the aperture round. *Pl.* VI, *fig.* 13.

18. *Fasciolites.*—A subcylindrical shell, formed of multilocular tubes, narrowing at both their ends, disposed contiguously and parallel; the tapering ends transversely and obliquely folded on each other. *Pl.* VI, *fig.* 14.

19. *Acamas.*—A multilocular, straight, and conical shell; mouth round and horizontal; siphuncle central; summit pierced by eight small tuberculated apertures, disposed round a stelliform figure; the septa conical, plaited at the bottom and plain at the edge. The substance spathose, similar to that of the *Belemnite.*

This fossil is figured and described by M. de Montfort. It was also noticed by Knorr; and was found by Annone in the neighbourhood of Prattelen, in the Canton of Basle. The termination of its summit is represented in *Pl.* VI, *fig.* 15.

20. *Amplexus.*—A nearly cylindrical shell, divided into chambers by numerous transverse septa; the septa embracing each other with their reflexed margins.
Fossil. *Pl.* VI, *fig.* 16.

We are indebted to Mr. Sowerby for the addition of this interesting genus to the multilocular shells. The fossil which was subjected to this gentleman's examination was found in the Black Rock, at Limerick; and bearing much of the appearance of a coral or madrepore, received the specific designation of *Amplexus coralloides*, its specific characters being, "Tube irregularly bent, longitudinally striated; margins of the septa deeply reflexed and regularly plaited. The septa are a fourth or a fifth part of the diameter distant from each other, with the margin reflexed to the next septum. The folds on the margin of the septa correspond in width to the longitudinal striæ of the tube, and are so deep as to form elongated cells, opening into the chambers; the lines of growth are close, and rather unequal in depth *".

21. *Conularia.*—A conical, hollow, univalve shell, divided by imperforate septa; the mouth half closed. *Pl.* VI, *fig.* 17.

This fossil was first described and figured by the Rev. Mr. Ure, in his "*History of Rutherglen and East Kilbride.*" It has also been particularly noticed by Mons. Denys de Montfort, as having been found in St. Peter's mountain, near Maestricht, and has been distinguished, by him, by the term *Pyrgopolon,* with the specific designation of *Mosæ,* but to which, perhaps, the term *teres* would be more applicable, the specimen figured by De Montfort agreeing, I conjecture, with *C. teres* of Mr. Sowerby, *Min. Conch., Tab.* CCLX, *fig.* 1, 2. We are obliged to Mr. Miller, of Bristol, for having instituted this genus. Mr. Sowerby describes and figures two species, *C. quadrisulcata, fig.* 17, and *C. teres.*

Besides the multilocular shells which are here particularised, many more, both in a recent and mineralised state, have been described by Bianchi, Soldani, Fichtell, Moll, Boys, Walker, and others, which are so minute as to require microscopical aid to discover, with correctness, even their forms. These objects of admiration occur in such variety of forms, of structure, and of richly varied markings, as nearly to foil the naturalist in his attempts at classification, and almost to authorise the mode of M. de Montfort, who places almost every shell under a distinct genus. Sixty genera have been already formed of these interesting domiciles, and many more, doubtlessly, lie hidden to reward the diligence of future enquirers.

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* Mineral Conchology, Vol. I, p. 165, *Tab.* LXXII.

When it is considered that these belong to only one division of shells, and that there remain to be added to these the microscopic univalved and bivalved shells, their multitude will certainly authorise these minute shells being described and treated of in distinct works; although their connection with the larger subjects of this class of Nature's works will demand their being studied with them, both by the conchologist and the oryctologist.

It has, however, been thought proper to introduce here, three of these shells to the reader's notice, on account of some particular circumstances in their history.

Miliolites saxorum, Lam. (*Pl.* VI, *fig.* 18.)—This minute species of fossil shell is known to form the principal part of the masses of stone in some of the quarries in the neighbourhood of Paris, Versailles, Champagne, &c. The recent shell has been found on Fucus, near the island of Corsica; and by Mr. Boys and Mr. Walker on our coasts, and was, by the latter writer, named *Serpula subovalis intorta**. It was also mentioned by Mr. Montague as *Vermiculum intortum*.

Cornu Ammonis Ariminiense, Planc. (*Pl.* VI, *fig.* 19), is the shell which Plancus and others classed with the *Cornu Ammonis*, considering them as the recent shells of this genus; but the discovery of fossil microscopic shells exactly analogous with the minute recent ones has shown their correspondence with each other, and that they are entirely different from the shells of the genus *Ammonites*.

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* Testac. minut. rarior. *Tab.* I, *fig.* 1.

Gyrogonites.—A spheroidal hollow fossil, of the size of a middling pin's head, having two poles, in which terminate five tubules turning from right to left, and making one revolution and a half round the spheroid. *Pl.* VI, *fig.* 20.

M. Léman has been enabled to discover a considerable close agreement between the form and structure of this fossil and of the seed-vessel of a small aquatic plant, *Chara vulgaris*, which has been described and figured by Gaertner; but, as the origin of this fossil is not, perhaps, fully determined, it is not removed from the situation which it has so long held.

These three last fossils are figured of their natural size, and as magnified by the microscope.

It may not be improper to observe, that the great numbers in which these and various other minute fossil shells have been found in different strata, render them very desirable objects of research to the scientific enquirer. There are several circumstances by which the oolitic bodies, which occur in such myriads as to give name to the formation in which they are contained, are pointed out as requiring still further examination with respect to their original mode of existence, and more satisfactorily to prove that they were not of animal origin.

Confining ourselves to the univalve multilocular shells which may be examined by the naked eye, it still remains to advert to some of those shells which have been marked by M. de Montfort with generic designations, and to notice the claims which they may possess for such distinction.

Angulithes.—A multilocular shell, with the characters of *Nautilus*, the mouth being of a triangular form. Triangular nautilite of Havre.

Bellerophron.—The *Shuttle Nautilus. Le Nautile de primé.* Sonnini.

Oceanie.—*Le petit Nautile ombiliqué.* Favanne.

The distinctions marking these shells can hardly be considered as more than specific characters; and it is with still less reason that the species of *Ammonites* now distinguished, by De Montfort, by the generic names *Aganides, Pelagus, Canthropes, Simplegades,* and *Amalthéa,* are removed from their original genus; since, if such differences as these exhibit are to be admitted as generic, with equal right generic titles might be claimed for many more of the hundreds of different shells which are numbered under the genus *Ammonites.*

Several of the additions which this author has made to the genera of straight multilocular shells appear to be founded on insufficient or even erroneous assumptions.

Paclites—is a fossil which Mr. Walch had described as a *Belemnite,* having a small circular hole at the extremity of a curved point, and, beneath this, a long narrow opening. This is described, by M. de Montfort, as terminating in a stellated sphincter, and having a plaited lateral slit; which does not accord with that of Mr. Walch, who both describes it and figures it as a *Belemnite,* with a small circular hole at the extremity of a curved point, and, beneath this part, a narrow small opening. De Montfort speaks of its having chambers and a central siphuncle, but does not state whether these are formed in the spathose substance, or whether they are of a shelly substance and fixed as an alveolus in the spathose substance.

Thalamus.—The fossil which is here referred to does not appear to have a single pretension to be placed in a distinct genus. The *Belemnites polymitus* of Scheuchzer is taken for its type, and the external markings which designate its generic characters are thus accurately described by Scheuchzer:—"Belemnites cujus superficies undique circulis concentricis est obsita."—*Lapid. figurat. Lub.* p. 15. Walch, who noticed the same markings, was of opinion that they were merely accidental, and were probably produced by the adhesion of flat spiral shells. But similar markings are frequently found on the green-sand fossils. I have it in several instances, and particularly on a *Belemnite* exactly agreeing with the description of the *Belemnites polymitus* of Scheuchzer. These markings are formed of patches of chalcedony, in rude sub-concentric forms, having somewhat of a stalagmitic appearance: I have seen a mass of chalcedony, its surface thus covered, and its substance apparently thus formed, from Devonshire, as large as a man's fist.

Amimomus.—The fossil for which this genus is formed is said to be figured in the Supplement to Knorr's work, *Tab.* IV, *fig.* 2, but no such fossil appears in the place to which we are referred.

Tiranites—is the name of a genus under which it is proposed to place a fossil described and figured by Knorr, *Supp. Tab.* XII, *fig.* 1 to 5; and also found in the neighbourhood of Rouen by M. de Montfort, who thus describes it:—"A free, chambered, straight, tubular cone; chambers undulated on the edges; the mouth oval, undulated, and horizontal; the top pointed, and the siphon central." Fragments only are found, some of which are three inches in diameter at their base; but the characters of the whole fossil do not appear to be sufficiently known to warrant the founding on them a new genus. It appears undoubtedly to have been a multilocular shell of a considerable size; but, previously to removing it from the genus *Orthoceratites*, and forming of it a genus by itself, it is certainly necessary that more of its generic characters should be determined.

Molossus—is a genus formed for the reception of a fossil, which is named, by Professor Blumenbach, *Orthoceratites gracilis*, and is described as—a free, chambered univalve; straight, conical, tubular, and intersected; chambers plain, in form of a drum; siphon lateral, continuous, round, and serving for a mouth; the top pointed; the base horizontal. Blumenbach describes the joints as being pyritical, which leads, with the account of the chambers being intersected, and the necessity of pointing out the continuity of the septa, to believe there might be an agreement between these bodies and the pyrites found at Dorking, which are cylindrical, pyritical bodies with slender points passing out at each end, much resembling those figured by M. de Montfort.

Echidnis—is a similar fossil with that which is figured as a species of *Orthoceratites* (*Org. Remains*, Vol. III, *Pl.* VII, *fig.* 14), its specific character being the alternate circular risings and depressions on its surface; but certainly no characters have yet been shown which mark it to be of a distinct genus.

Achelois.—The fossil, figured by De Montfort, as the type of this genus, as being of a conical form, with conical septa, and for which reference is also made to Knorr, Tom. II, sect. 1, *Pl.* II, A. VIII, and *Supp. Tab.* IV, *fig.* 1, is very unsatisfactorily described; nor is this description aided by reference to Knorr, the figures there not agreeing with either De Montfort's account or figure. A sufficient knowledge of the characters of this fossil is certainly not yet known to warrant a genus being formed from it.

Calirrhoe.—This genus is formed for the reception of a fossil which is, undoubtedly, only the camerated alveolus of a *Belemnite*, such as is seen *in situ*, *Pl.* VI, *fig.* 11, and which is frequently seen bearing all the appearances attributed to this fossil.

Telebois—is appropriated to a fossil, the nature of which has been undoubtedly mistaken by De Montfort. It is, obviously, part of a vertebral column of the turban *Encrinite*, as hereafter described, and as figured in *Organic Remains*, Vol. III, *Pl.* XV, *fig.* 8, and was, indeed, considered as such by Mr. Walch.

Cetocis.—Mr. Walch considered this fossil as a *Belemnite;* but it having a stellated opening at its pointed termination, it is placed, by M. de Montfort, in this genus.

Hibolithes—is a genus formed to receive the fusiform *Belemnite* figured in Vol. III, *Pl.* VIII, *fig.* 13, of *Organic Remains.* The form of this fossil, which possesses every character of the *Belemnite*, cannot be considered as more than a specific difference.

Porodragus—is a genus formed, by this author, on a *Belemnite*, bearing the same form as the last described; but having a round horizontal mouth; central siphon, conic, smooth partitions; a groove on the outer surface; and being superficially pierced with numerous longitudinal pores. The partitions, siphon, &c., of this fossil are those which are to be found in every species of *Belemnite;* but the pores, existing on the surface, are difficult of explanation. If formed by the animal belonging to the shell, as supposed by M. de Montfort, we may have a right to conclude that the *Belemnite* was invested by the animal which formed it.

Bivalves, *Conchifera*, Lam.

Tubicolæ—bivalve shells, contained in a tubular sheath distinct from the valves: and which are either incrusted entirely, or in part, in the sides of the sheath, or project beyond it.

GENUS 1. *Aspergillum.*—A tubular, testaceous sheath, diminishing gradually towards its fore part, where it is open, and enlarging to a club-shaped form towards the other extremity; the club having two valves incrusted on the side of its inner substance. The terminal disk of the larger end is convex, furnished with subtubular foramina, and has a fissure in the centre. *Pl.* III, *fig.* 21.

Serpula penis, Lin.

2. *Clavagella.*—A tubular testaceous sheath, diminishing to an opening anteriorly, and terminating behind in an oval and club-shaped form, set with spiniform tubes; the clavated termination displaying, on one side, one valve fixed in its substance, the other valve being loose in the sheath.

Fistulana echinata. Ann. du Mus. Tom. VII; *Teredo echinata,* Brocch. Vol. II, *Tab.* XV, *fig.* 1.

3. *Fistulana.*—A tubular, and, most frequently, a testaceous sheath, lessening towards its anterior end, which is open, and including a loose bivalve shell, gaping when the valves are united.

This differs from the preceding *Tubicolæ* in neither of the valves of the included shell being imbedded in the substance of the sheath.

Fistul. ampullaria, Ann. du Mus. Vol. VII, p. 428.

4. *Septaria.*—A very long testaceous tube, tapering in its fore part, and internally subdivided by vaulted septa, generally incomplete. The anterior part of the tube is terminated by two other very thin tubules, not internally divided.

Serpula polythalamia, Lin.

These are generally of considerable size; but Lamarck is of opinion that they, perhaps, should not be separated from the preceding genus.

5. *Teredina.*—A cylindrical, tubular, testaceous sheath, closed posteriorly, and showing the two valves of the shell at the open anterior extremity.

Fistulana personata, Ann. du Mus. Vol. VII, p. 429; Vol. XII, *Pl.* XLIII, *fig.* 6, 7. *Organic Remains,* Vol. III, *Pl.* XIV, *fig.* 10.

6. *Teredo*—of Lamarck, is the genus in which he has disposed *T. navalis.*

Mr. Sowerby, who has considerably illustrated this genus, describes it as " a bivalve, gaping; back and posterior side closed by membrane or shelly valves terminating an accessory shelly tube; hinge with one tooth in the right valve; a long free process arising from the beaks contained in each valve.

" The principal valves are longer than broad, striated and gaping at both sides and at the back; in the posterior side of each is a deep rectangular sinus; in the anterior side is a corresponding small rounded sinus; the front is lanceolate, with an internal tubercle at the extremity; one of the accessory valves lies over the beaks, and is lobed; another is trapezoidal, covering the sinus at the posterior side; it has a line down the middle where there may possibly be an opening, or it may indicate two valves. The membrane which covers the shell is extended over the anterior side, forming a taper tube many times longer than the proper shell, and strongly impregnated, at a little distance from the valves, with shelly matter: in the extremity of this lie two spatulate valves, attached by muscles to the animal, and capable of closing the aperture, in which is placed a longitudinal septum; this tube is slightly attached to a tortuous passage bored in the wood by the animal, and is elongated, and gradually increased in diameter, as the animal recedes further into the wood.' '

Mr. Sowerby refers to the recent species, *T. navalis,* and to the fossil species which he terms *T. antenautæ,* from their having existed before ships were invented, he refers all those found in calcareous or siliceous wood. Among the former he has seen none which show any of the accessory valves, except the tube and the two spatulate valves attached to the animal. Even the membrane that is preserved in the fossil ones covering the proper shells, and attaching them to the outside of the tube, is not discoverable in the recent specimens *.

Pholadairiæ—bivalves, either with or without accessory pieces, and gaping anteriorly.

1. *Pholas.*—An equivalved, transverse bivalve, gaping on each side; with various shelly accessory pieces placed above or beneath the hinge; the posterior or inferior border of the valves reflected upwards. Recent.

2. *Gastrochæna.*—An equivalved, subcuneiformed bivalve; the opening anteriorly oblique, very large and oval; posteriorly, hardly any. The hinge linear, marginal, and without teeth.

This genus of Spengler differs from the preceding chiefly in being without accessory pieces.

Solenacea—bivalves elongated transversely, without accessory pieces, and gaping only at the lateral extremities; the ligament external.

1. *Solen.*—An equivalved bivalve, elongated transversely; gaping at the ends; the beaks very small, not projecting; small cardinal teeth, varying in their number, sometimes none; the ligament external. Recent and fossil. *Pl.* VII, *fig.* 24.

2. *Panopæa.*—A transverse, equivalved bivalve, gaping unequally at the sides; one conical hinge tooth,

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* Mineral Conchology, Vol. II, p. 229. The accompanying figures, Pl. CII, are very satisfactorily illustrative of the nature of this genus.

in each valve, with a short, compressed, ascending callosity; the ligament external, fixed to the callosities on the longer side of the shell.

3. *Glycimeris.*—A transverse bivalve, gaping very much on each side; the hinge callous, without teeth; nymphæ projecting outwardly; the ligament external. Recent and fossil. *Pl.* VI, *fig.* 27.

Myariæ—Bivalves; inequilateral and subequivalved; a spoon-formed tooth on one or both valves, giving attachment to the ligament; the shell gaping at one or both extremities.

1. *Mya.*—A transverse bivalve, gaping at both sides; one large, compressed, and dilated roundish cardinal tooth, to which the ligament is attached, projects almost vertically, and, when the valves close, lies upon the ligamental pit of the other valve. Recent and fossil. *Pl.* VII, *fig.* 16.

2. *Anatina.*—A transverse, subequivalved, gaping bivalve, with a flat spoon-shaped tooth on each valve; with, sometimes, a falcated plate running obliquely beneath the hinge teeth. Recent.

Mactraceæ—equivalved bivalves; generally gaping at the lateral extremities; the ligament internal, with or without a complication with the external ligament.

1. *Lutraria.*—An inequilateral bivalve, transversely oblong or rounded, gaping at the lateral extremities; the hinge with one tooth as if plaited into two; or two teeth, one of which is simple; with an adjoining oblique, deltoidal pit, internally projecting; no lateral teeth; ligament internal. Recent and fossil. *Pl.* VII, *fig.* 29.

2. *Mactra.*—A transverse, inequilateral, subtrigonal bivalve, a little gaping at the sides; the beaks prominent; a compressed grooved cardinal tooth, with an

adjoining pit; two lateral compressed inserted teeth; ligament internal. Recent and fossil. *Pl.* VII, *fig.* 30.

3. *Crassatella.*—An inequilateral, suborbicular, or transverse, close shell; hinge complicated, two cardinal teeth slightly diverging with a pit at the side; ligament internal; lateral teeth, obsolete or none. Recent and fossil. *Pl.* VIII, *fig.* 9.

4. *Erycina.*—A transverse, subinequilateral, equivalved bivalve, seldom gaping; two unequal, diverging cardinal teeth, with an interposed pit; two lateral, oblong, compressed, short penetrating teeth; the ligament internal. Recent and fossil. *Pl.* VIII, *fig.* 10.

This is an equivocal genus; the character of the hinge being, with difficulty, ascertained.

5. *Ungulina.*—A longitudinal or subtransverse bivalve, nearly equilateral, and with close valves; one short subbifid cardinal tooth on each valve by the side of an oblong marginal pit, nearly divided in two; the ligament internal. Recent.

6. *Solemya.*—An equilateral, equivalved, transversely oblong bivalve; beaks hardly distinct; a dilated, compressed, very oblique cardinal tooth in each valve, with a slight concavity receiving the ligament. Recent.

7. *Amphidesma.*—A transverse, inequilateral, suboval bivalve, sometimes a little gaping at the sides; the hinge with one or two teeth, and a narrow small pit for the internal ligament, there being another external.

II. *Corbuleæ.*

1. *Corbula.*—A regular unequivalved, inequilateral bivalve; a hinge tooth on each valve; conical, curved, and elevated, with a pit at the side; no lateral teeth;

ligament internal. Recent and fossil. *Pl.* VII, *fig.* 20.

2. *Pandora.*—A regular, unequivalved, inequilateral, transversely oblong bivalve; the upper valve flat, with two oblong obtuse teeth, the lower one convex. Recent.

Mr. G. Sowerby considers that this shell possesses only one obtuse tooth on the flat valve.

The lithophagous shells, without tube, or accessory pieces, are rounded or obtuse at the ends, more or less gaping forwards, with the ligament external. They are divided, by Lamarck, into three genera:—

1. *Saxicava.*—A transverse bivalve; hinge without teeth.

2. *Petricola.*—A transverse, inequilateral bivalve, narrower in the fore part; with two teeth on one, or on both valves. *Pl.* VII, *fig.* 22.

3. *Venerupis.*—A transverse, inequilateral shell, very short in the hind part; the hinge with two teeth on one valve and three on the other, and sometimes with three on each valve.

Nymphaceæ—with two cardinal teeth, at the most, on the same valve; a little gaping at the lateral extremities; the ligament external; the ligamental cartilage projecting.

1. *Sanguinolaria.*—A transverse subelliptical shell, gaping a little at the sides; the upper margin bowed, not parallel with the lower; the hinge with two approximated teeth in each valve. Recent, *Pl.* VII, *fig.* 25.

2. *Psammobia.* — A transverse, elliptical, or oval-oblong bivalve, rather flat, and a little gaping on each

side; the beaks prominent; the hinge with two teeth on the left valve, and only one, penetrating, on the opposite valve.

3. *Psammotea.*—A transverse, oval, or oval-oblong bivalve, a little gaping at the sides; one cardinal tooth in one, and sometimes in both, valves.

The three preceding genera bear somewhat of the form of *Tellens.*

4. *Tellina.*—A transverse or orbicular shell, for the most part flattish; angular on the anterior side, on which is a flexuous and irregular fold; one or two hinge teeth on the same valve; two lateral teeth, genenerally remote. Recent and fossil. *Pl.* VIII, *fig.* 16.

5. *Tellinides.* — A transverse, inequilateral shell, rather flat, and slightly gaping at the sides; the beaks small; no fold on the margin; the hinge with two diverging teeth on each valve; two lateral, nearly obsolete teeth, the posterior one of which, in one valve, is placed near to the hinge.

Only one species is known.

6. *Corbis.*—A transverse, equivalved bivalve, without any irregular fold at the anterior border; the beaks curved inwards, opposite to each other; two hinge teeth; two lateral teeth, the hinder of which comes near to the hinge; the impressions simple. Recent and fossil.

Separated from *Lucina* by the impressions not being complicated; and, from *Tellina,* by having no fold.

7. *Lucina.* — A suborbicular, inequilateral bivalve, with small, pointed, oblique beaks; two diverging hinge teeth, one of which is bifid, these being variable or disappearing with age; two lateral teeth, one of which approaches the hinge; two lateral impressions, one of which is considerably extended posteriorly; the ligament external. Recent and fossil. *Pl.* VIII, *fig.* 15.

8. *Donax.*—A transverse, equivalved, inequilateral bivalve, the anterior side very short and obtuse; two hinge teeth on each valve, or on one only; one or two lateral teeth, more or less remote; the ligament external, short, and at the lunule. Recent and fossil. *Pl.* VIII, *fig.* 11.

9. *Capsa.*—A transverse, equivalved, close shell, the hinge having two teeth on the right valve, one bifid penetrating tooth in the other valve; no lateral teeth; the ligament external.

A general idea of the hinge of this genus may be gained from *Pl.* VII, *fig.* 22.

10. *Crassina.*—A suborbicular, transverse, close, equivalved, subinequilateral bivalve; the hinge with two strong diverging teeth on the right valve, and two unequal teeth in the other; the ligament external, and in the longest side.

This shell is distinguishable from a small *Crassatella* by the situation of the ligament; and, from *Venus*, by having only two teeth on each valve.

Lamarck forms the family of *Conchæ* for the reception of the following shells:—

Fresh-water shells—*Cyclas, Cyrene,* and *Galathea.*

Sea shells—*Cyprina, Cytherea, Venus,* and *Venericardia.*

1. *Cyclas.*—An oval, rather tumid, transverse, and equivalved bivalve; the hinge teeth very small, sometimes hardly any; sometimes two on each valve, of which one is divided into two; and sometimes there is only a plicated or lobated one on one valve and two on the other; the lateral teeth are compressed, and extended transversely; the ligament is external.

The recent shells are very thin and fragile, and sometimes transparent.

2. *Cyrena.*—A roundish, trigonal, solid, thick, tumid, inequilateral shell; the hinge with three teeth on each valve, the lateral ones always two, and of which one often approaches the cardinal ones; the ligament external, attached to the largest side.

These have been confounded with the *Cyclades.* They are not known in Europe in a recent state; some of the species have their lateral teeth serrulated. *Pl.* VIII, *fig.* 14.

3. *Galathea.*—A subtrigonal, equivalved bivalve; the hinge teeth grooved; two in the right valve, united at their base; and three in the other valve, the intermediate one being distinct and forward; the lateral teeth remote; the ligament external.

Venus paradoxa, Born. *Galathea radiata, Ann. du Mus,* Tom. V, *Pl.* XXVIII.

Conchæ Marini. Rarely with epidermis or lateral teeth.

1. *Cyprina.*—An equivalved, inequilateral, and obliquely cordated bivalve; three unequal cardinal teeth; one lateral tooth on the anterior side, sometimes obsolete.

2. *Cytherea.*—An equivalved, inequilateral, suborbicular, trigonal or transverse shell; four cardinal teeth on the right valve; three diverging, approximated at their base, and one, entirely separate, under the lunule; three diverging corresponding teeth in the other valve; with a separate pit. No lateral teeth.

3. *Venus.*—An equivalved, inequilateral, transverse or suborbicular shell; three cardinal approximated teeth on each valve, the lateral ones diverging from the summit; the ligament external. Recent and fossil. *Pl.* VIII, *fig.* 7.

Cardiaceæ—teeth irregular either in form or situation.

1. *Venericardia.*—An equivalved, inequilateral, suborbicular bivalve, most commonly with longitudinal ribs; the hinge, two cardinal teeth, in the same direction. Recent and fossil. *Pl.* VIII, *fig.* 2.

2. *Cardita.*—A free, inequilateral, equivalved bivalve; the hinge with two unequal teeth, one short and straight under the beaks, the other oblique and marginal, extended beneath the corselet. Recent and fossil. *Pl.* VII, *fig.* 27.

3. *Cardium.*—A subcordiform equivalve, protuberant at the base, the valves plicated or dentated on their inner margin. The hinge with four teeth in each valve: two oblique approximating cardinal teeth, those of each valve receiving each other crosswise; two lateral ones, remote and inserted. Recent and fossil. *Pl.* VIII, *fig.* 12.

4. *Cypricardia.*—An equivalved, inequilateral bivalve, extended transversely and obliquely, with three teeth under the beaks, and a lateral one under the corselet.

Differing from *Cardita* in having, instead of one tooth under the beaks, three, like *Venus.*

5. *Isocardia.*—An equivalved, cordiform, ventricose bivalve; the beaks separate, diverging, and turned in a spiral; two flat, inserted cardinal teeth, one of which is recurved under the beak; a lateral tooth extended beneath the corselet; the ligament external. Recent and fossil. *Pl.* VIII, *fig.* 8.

Arcaceæ—with numerous small penetrating teeth disposed on both valves in a straight or bent line.

1. *Cucullea.*—An equivalved, inequilateral, trapeziform, ventricose shell, with detached beaks, sepa-

rated by a ligamental area; the impression forwards, forming a projection with an angular border; the hinge linear, straight, set with small transverse teeth, with from two to five at the ends, disposed obliquely. Recent and fossil. *Pl.* VIII, *fig.* 20.

2. *Arca.*—A transverse, subequivalved, inequilateral shell, with distant beaks, separated by the ligamental area; the hinge straight and linear, formed by numerous teeth closely set in a row: the teeth of one valve inserted between those of the other; the ligament external. Recent and fossil. *Pl.* VIII, *fig.* 17.

3. *Pectunculus.* — An orbicular, almost lenticular, equivalved, close, and subequilateral bivalve; the hinge with numerous teeth, obliquely inserted in bent rows, obsolete and scarcely any in the middle; the ligament external. Recent and fossil. *Pl.* VIII, *fig.* 19.

4. *Nucula.*—A transverse, ovato-trigonal or oblong, equivalved and inequilateral bivalve; no intermediate areas; the hinge linear, with numerous teeth like those of a comb; the beaks contiguous, inflected backwards; the ligament marginal, partly internal, inserted in a pit at the hinge. Recent and fossil. *Pl.* VIII, *fig.* 18.

Trigoniæ. With lamelliform teeth, transversely striated.

1. *Trigonia.*—An equivalved, inequilateral, trigonal, and, sometimes, suborbicular bivalve; the hinge teeth oblong, flat on their sides, diverging, and grooved transversely, the two on the right valve being grooved on both sides, and received between the two on the left valve, which are double and grooved only on the insides; the ligament external and marginal. Recent and fossil. *Pl.* VIII, *fig.* 3.

2. *Castalia.* — An equivalved, inequilateral, trigonal shell; the beaks recurved; the hinge with two teeth;

one backward, short, and slightly trilamellated, with transverse striæ; the other forward, longitudinal, and lateral; ligament external. Recent.

A rare shell, apparently from fresh water.

Naiades.

Fresh water shells, having one irregular hinge tooth, simple or divided, and one longitudinal tooth extended under the corselet: sometimes, without any tooth; but having, along its base, irregular, granular tubercles. Impression posteriorly compound; furnished with an epidermis worn off at the beaks.

1. *Unio.* — A transverse, equivalved, inequilateral bivalve; impression complicated; the hinge with two teeth in each valve; one, short, irregular, simple or divided, and substriated hinge tooth; the other, lateral, compressed, and elongated under the corselet; ligament external. Recent and fossil. *Pl.* VII, *fig.* 19.

2. *Hyria.*—An equivalved, obliquely trigonal, eared bivalve, with a straight and truncated base; the hinge formed of two spreading teeth; the hinder, or cardinal, divided into many parts, of which the inner are the smallest; the other, the anterior or lateral, very long and lamellar; the ligament external and linear.

This genus resembles *Anodonta* in its form.

3. *Anodonta.*—An equivalved, inequilateral, transverse bivalve; the hinge linear, with no tooth; a smooth cardinal plate, truncated so as to form a sinus at its anterior extremity, forms the base of the shell; the impressions are two, remote and lateral; the ligament is external and linear, placed at the anterior extremity in the groove of the hinge plate. Recent. *Pl.* VI, *fig.* 26.

4. *Iridina.*—Differs from *Anodonta* only in its hinge line being irregularly tuberculated. Its shell has considerable pearly lustre.

Chamaceæ. Inequivalved, irregular, and attached, with one large tooth at the hinge, and two impressions.

1. *Diceras.* — An inequivalved, adherent bivalve, with very large, conic, divaricating beaks, turned in irregular spires; a large, thick, concave, subauricular tooth in the larger valve; two muscular impressions.

One species only has been seen of this shell, and that in a fossil state.

2. *Chama.* — An irregular, inequivalved, fixed bivalve, with recurved beaks; the hinge one thick, oblique, subcrenulated tooth, received in a pit in the opposite valve; two distant lateral impressions; the ligament external, sunk. Recent and fossil. *Pl.* VII, *fig.* 17.

3. *Etheria.*—An irregular, adherent, unequal-valved bivalve, with short beaks, as if sunk in the base of the valves; the hinge without tooth, waved and rather sinuous and unequal; two distant, lateral, oblong, muscular impressions; the ligament external, tortuous, and partly penetrating into the shell.

A very rare large shell, of beautiful pearly lustre, adherent to the rocks at great depths. Only known in a recent state *.

Tridacnæ. Transverse, equivalved; one large laterally extended impression.

1. *Tridacna.* — A regular, equivalved, inequilateral, transverse bivalve, gaping at the lunule; the hinge with two compressed, unequal, forward, inserted teeth; the ligament external and marginal. Recent and fossil? *Pl.* VII, *fig.* 26.

2. *Hippopus.*—Differs from the preceding in its lunule being close.

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* This genus is beautifully illustrated in Mr. G. Sowerby's work on the genera of shells, from which this definition has been taken.

Mytilaceæ. Hinge, an almost internal, marginal, linear ligament. Many of these shells attach themselves by a byssus.

1. *Modiola*. — A subtransverse, equivalved bivalve, very short on the hinder side; the beaks sublateral, lying on the shorter side; the hinge lateral, linear, and without teeth; the cardinal ligament rather internal, placed in the marginal groove; one sublateral, hatchet-formed impression. Recent and fossil. *Pl.* VI, *fig*. 25.

2. *Mytilus*.—A longitudinal, equivalved, regular bivalve, pointed at its base; the beaks nearly straight, terminal and pointed; the hinge lateral, generally without teeth; the ligament marginal, and rather internal; one long, clavated, and sublateral impression. Recent and fossil. *Pl.* VI, *fig*. 24.

3. *Pinna*.—A longitudinal, wedge-formed, equivalved bivalve, gaping at its summit, pointed at its base, and having straight beaks; the hinge lateral, without teeth; the ligament marginal, linear, very long, and rather internal. Recent and fossil. *Pl.* VI, *fig*. 23.

Malleaceæ. A marginal, sublinear ligament, either simple or interrupted by rows of teeth, or crenulæ; the shell lamellous.

1. *Crenatula*. — A flat, lamellated, subequivalved, rather irregular bivalve; the hinge sublateral, linear, marginal, and crenulated; the crenulæ in rows, callus hollowed into pits, which receive the ligament; no groove for byssus. Recent and fossil. *Pl.* VIII, *fig*. 22.

2. *Perna*.—A subequivalved, flattish bivalve, with lamellar texture; the hinge linear, marginal, formed of transverse, parallel, sulciform teeth, not penetrating, and between which the ligament is inserted; a posterior

groove, rather gaping, for the byssus, under the extremity of the hinge, with callous sides. Recent and fossil. *Pl.* VIII, *fig.* 21.

3. *Malleus.*—A rough, subequivalved bivalve, generally elongated; sublobated at the base; with small divaricating beaks; the hinge edentulous; an oblong, conical small pit under the beaks, traverses obliquely the ligamental groove; the ligament, which is short and almost external, is inserted in the sloping depression in each valve. Recent. *Pl.* VII, *fig.* 5.

4. *Avicula.*—An inequivalved, fragile, rather smooth bivalve; the base transverse and straight, with produced extremities and caudiform anteriorly; the left valve notched; the hinge linear, with a tooth in each valve beneath the beaks; the ligamental area marginal, narrow and grooved, not traversed by the byssus. Recent and fossil. *Pl.* VII, *fig.* 6.

5. *Meleagrina.*

This genus differs from *Avicula* in being nearly equal valved, of a roundish square figure, with no hinge tooth, and in having its ligamental pit always dilated in its middle part.

Pectinideæ. Ligament chiefly internal; the shell, in general, regular and compact.

1. *Pedum.*—An inequivalved, slightly eared bivalve, the valves terminating at the base in a triangular disk, with a furrow across that of the lower valve, and a cicatrix across that of the upper, for the attachment of the hinge ligament; the hinge toothless; the lower valve notched in the left side near the hinge *. Recent. *Pl.* VII, *fig.* 7.

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* The chief particulars respecting this genus are derived from Mr. G. Sowerby's more extended, and, necessarily, more complete description, in the work already referred to.

2. *Lima.*—A longitudinal, subequivalved, eared bivalve, gaping a little on one side of the valves; the beaks separated, their inner surface rather everted; the hinge toothless; the hinge-pit, receiving the ligament, partly external. Recent and fossil. *Pl.* VII, *fig.* 3.

3. *Plagiostoma.*—A free, subequivalved, slightly eared bivalve; the base transverse and nearly straight; the beaks rather separated, their inner surfaces extended in flat, transverse areas, disposed rather externally; one straight, the other inclined obliquely; the hinge without a tooth; a conical hinge-pit under the beaks, partly internal, and opening externally. Fossil. *Pl.* VII, *fig.* 12.

4. *Pecten.*—A free, regular, unequal valved, eared bivalve; the lower edge transverse and straight; the beaks contiguous; the hinge without teeth, with a trigonal hinge-pit entirely internal for the ligament. Recent and fossil. *Pl.* VII, *fig.* 2.

5. *Plicatula.*—An unequal valved bivalve, contracted towards its base; the upper margin rounded, and subplicated; the beaks unequal, and with no cardinal areas; the hinge with two strong teeth on each valve, with a pit between receiving the ligament, which is entirely external. Recent and fossil. *Pl.* VIII, *fig.* 4.

The shell, named *Harpax*, in *Org. Remains*, Vol. III, and figured, *Pl.* XII, *fig.* 14, 15, 16, 17, and 18, differs from *Plicatula* of Lamarck, in being an attached shell, and in having its teeth not disposed like those of *Spondylus*, but in the form of a V, and in being crenulated. It appears to agree, in its specific properties, with *P. tubifera* of Lamarck.

6. *Spondylus.*—An unequal valved, adherent, eared bivalve, rough or echinated; the beaks unequal; the lower

valve having a flat external cardinal area, divided by a groove; the hinge has two strong teeth on each valve, with an intermediate pit for the ligament, communicating by its base with the outer groove; the ligament internal.

Recent and fossil. *Pl.* VIII, *fig.* 6.

7. *Podopsis.*—An unequal valved, subregular bivalve, not eared, adhering by the beak of its lower valve; the lower valve is larger and more convex than the upper, and has its beak more advanced; the hinge is without teeth, and the ligament internal.

These shells are only known as fossils: the upper valve has no curved or projecting beak, nor is the lower beak recurved over the side or the upper valve, as in *Gryphæa.* They more resemble the *Pectens* in the regularity of their forms and their longitudinal striæ.

Ostracea. The ligament internal or semi-internal; the shell irregular and foliaceous, or even, sometimes, papyraceous.

1. *Gryphæa.*—An unequal valved free bivalve, the inferior valve large and concave; the beak large, incurved, and terminating in an involuted spire; the upper valve small and flat like an operculum; the hinge edentulous; the hinge-pit oblong and bowed; one impression.

Recent and fossil. *Pl.* VII, *fig.* 1.

Le Chev. de Lamarck states his having seen, at Paris, one species in a recent state.

2. *Ostrea.*—An adherent, inequivalved, irregular bivalve, the beaks disjoined; the valves becoming more unequal with age, so that the upper valve is gradually protruded; the hinge is toothless; the ligament semi-internal, affixed in the hinge-pit, which, in the lower valve, increases with the beak to a considerable length.

Recent and fossil. *Pl.* VI, *fig.* 29.

3. *Vulsella.*—A long, subequivalved, irregular, free bivalve, with equal beaks; the hinge having, upon each valve, a projecting callosity, with a conical ligamental

pit obliquely bowed. Recent and fossil. *Pl.* VII, *fig.* 4.

4. *Placuna.*—A free, irregular, flat, subequivaled bivalve; the hinge has interiorly, on one valve, two longitudinal sharp ribs, approximated at their base, and diverging in the form of a V; and, on the other, two corresponding depressions; at this part the ligament is attached. Recent and fossil. *Pl.* VIII, *fig.* 5.

5. *Anomia.*—An unequal valved, irregular, operculated bivalve, adherent by its operculum; one valve, which is pierced, is generally flat, having a hole or notch at its base; the other, a little larger, whole and concave; the operculum is small, elliptical, and subosseous, and is affixed to various marine bodies. Recent and fossil. *Pl.* VII, *fig.* 10.

Under the designation *Les Rudistes,* Lamarck places those shells in which neither the hinge, the ligament of the valves, nor the muscle of attachment, is discoverable: these he places under six genera—*Spherulites, Radiolites, Calceola, Birostrites, Discina,* and *Crania.*

1. *Spherulites.*—An unequal valved, orbiculato-globose bivalve, a little depressed at the top; outwardly echinated with large subangular scales; the upper valve small, opercular, and flattish, and furnished, on its inner surface, with two unequal, subconical, curved tuberosities; the lower valve larger, rather subventricose, with squamæ radiating beyond its border; the cavity is obliquely conical, having, on one side, a keel or ridge, as if formed by a fold of the inner surface, which is transversely striated; the hinge is unknown.
Fossil.

There is only one species known. From the Isle of Aix.

2. *Radiolites.*—An unequal valved bivalve, striated externally with longitudinal rays; the lower valve,

which is the larger, is turbinated; the superior is convex or conical, like an operculum; the hinge is unknown.
Fossil. *Pl.* VI, *fig.* 22.

3. *Calceola.*—An unequal valved, triangular, subturbinated bivalve, flat beneath; the large valve like a hood, obliquely truncated at its opening; the hinge-margin straight and transverse, being slightly notched and dentated in its middle; the upper margin bowed; the less valve flat, semiorbicular, like an operculum, with two lateral tubercles on its hinge-margin, and, in its centre, a small pit. Fossil. *Pl.* VIII, *fig.* 24.

4. *Acardo.*—A flat, nearly equivalved bivalve, having neither hinge nor ligament, with one impression in the centre of the valves. Recent. *Pl.* VI, *fig.* 21.

This shell is admitted, by Lamarck, in *La Systeme de la Nature,* but is not mentioned in his *Histoire Naturelle des Animaux sans Vertebres.*

5. *Birostrites.*—An unequal bicornuted bivalve; the disks of the valves raised into unequal, rather straight, obliquely divaricating cones, resembling horns, the base of the shortest being surrounded by that of the other.

Found only as a Fossil. Its locality does not appear to be known.

6. *Discina.*—An unequal valved, ovate, roundish bivalve, a little depressed; the valves equal in size, with a very distinct orbicular disk on each; the disk of the upper valve submammillated and undivided, the mammillæ surrounded by fine radiating striæ; the other valve very white, and divided by a transverse slit: there is no trace of hinge, ligament, or impression. Recent.

7. *Crania.*—An unequal valved, suborbicular bivalve; the under valve flat, fixed beneath, the inne surface pierced with three unequal and oblique foramina; the upper valve is convex, subgibbous, with two prominent callosities at its base. Fossil. The under valve. *Pl.* VII, *fig.* 21.

Brachiopodes, conchifera: Having, near their mouths, two opposite elongated ciliated arms rolled in spirals when at rest. Mantle, with two lobes separated forwards, wrapping up or covering the body. A bivalve shell adherent to marine bodies either immediately or by a tendinous cord.

The genera of this family are — *Orbicula*, *Terebratula*, and *Lingula*.

1. *Orbicula*.—A suborbicular, unequal valved bivalve, with no perceivable hinge; the lower valve is very thin, flat, and affixed beneath; the upper valve is subconical, with a pointed top, more or less prominent.

This shell is described, by Muller, *Zool. Dan. I*, p. 14, *Tab*. V, *fig*. 1-7; and, by Poli, *Conch*. Vol. II, p. 189, *Tab*. XXX, *fig*. 15.

A fossil shell of this description is found in the iron stone nodules in Shropshire and Worcestershire.

2. *Terebratula*.—An inequivalved, regular, subtrigonal bivalve, attached to other bodies by a short tendinous pedicle; the largest valve has an advanced beak generally incurved, and pierced either by a round hole or a notch, through which its organ of attachment passes; the hinge with two teeth. In the inner part are two subosseous, thin, forked, and variously ramified branches, proceeding from the disk of the small valve, and supporting the animal. Recent and fossil. *Pl*. VII, *fig*. 23.

3. *Lingula*.— A subequivalved, flat, ovally oblong bivalve, truncated at its top; rather pointed at its base; raised on a fleshy tendinous pedicle, and fixed to marine bodies; the hinge toothless. Recent and fossil. *Pl*. VI, *fig*. 28.

Cirrhipeda. Soft animals, without head or eyes, fixed and testaceous. The shell either sessile, or raised on a flexible tendinous pedicle.

Sessile. Shell fixed generally on marine bodies: the mouth in the upper and anterior part.

1. *Tubicinella.*—A straight cylindraceo-tubular operculated shell, attenuated towards its base, girt with transverse annular ribs; truncated at both ends, shut at the bottom by a membrane, and open at the top. The operculum formed of four small obtuse valves.

Attached to the whale; but not known in a mineralised state.

2. *Coronula.*—A sessile, suborbicular, or subconical shell, the extremities truncated; the sides thick; hollowed out internally into radiating cells. The operculum formed by four small obtuse valves. Recent and fossil.

Pl. VIII, *fig.* 27—The figure given here is of the fossil *Coronula* of the whale.

3. *Balanus.*—A sessile, affixed, conical univalve, the apex truncated; the base closed by an adherent testaceous plate; the opening subtrigonal or elliptical; the operculum internal, with four moveable valves inserted near the inner base of the shell. Recent and fossil. *Pl.* VIII, *fig.* 26.

4. *Acasta.*—A sessile body, composed of separable pieces, with a convex base, and a four-valved operculum. Recent.

5. *Creusia.*—Sessile and subglobular, formed of four valves, and having an internal bivalved operculum. Recent.

6. *Pyrgoma.*—Sessile, subglobular, with a bivalved operculum: found on *Astreæ, Madrepores,* &c. Recent.

Pedunculated. Supported by a moveable, coriaceous, tubular peduncle, attached by its base to marine bodies.

1. *Anatifa.*—A pedunculated, five-valved shell; the valves unequal, pressed together so as to be nearly con-

tiguous; the lowest on the sides being the largest. Recent. *Pl.* VIII, *fig.* 28.

2. *Pollicipes.*—A pedunculated shell, formed of thirteen or more subcontiguous, unequal valves; the lowest at the sides, being the smallest. Recent

Lepas scalpellum, Lin.; *Lepas mitella,* Lin.; *Lepas pollicipes,* Gmelin.

3. *Cineras,* Leach.

A pedunculated shell, with five oblong separate valves, not entirely covering the body; two at the sides of the opening, the others dorsal. Recent.

Lepas coriacea, Pallas.

4. *Otion.*—A pedunculated shell, with two separate small semilunar testaceous valves adhering near the lateral aperture. Recent.

Lepas aurita, Lin.

Trigonellites.—A slightly rounded, trigonal, thick shell, gaping on each side. The inferior margin nearly on a straight line; the anterior and superior margins in a gently waving line. The outer surface of each valve pierced by numerous foramina, which, passing nearly through its substance, give it the cancellous appearance of bone; the inner surface smooth, but marked with striæ, agreeing, in their direction, with the posterior and anterior margin. The assumed hinge completely linear, without teeth; there being only, on the posterior margin of each valve, an appropriate, linear surface for the attachment of cartilage or ligament externally. There is no appearance of muscular attachment. *Pl.* VIII, *fig.* 29.

The nature of the substance placed under this vague designation and description is entirely unknown. It bears no resemblance in its structure to any known testaceous, crustaceous, or boney fabric. Its appearance, as fixed in the calcareous fissile stone of Pappenheim, in the above figure, gives the idea of the valves of a shell; but examination shows, that, if these valves were brought together, they would touch only at two points, leaving all else, except at the inferior line, open.

The following shell is, in fact, neither univalve nor bivalve; for, though a bivalve in form, the two parts are connected, not by a hinge, but rather by suture.

Hyalæa.—An inequivalved, tumid, and transparent shell; tricuspidated at the base; gaping beneath the prominent beak. Recent. *Pl.* VII, *fig.* 7.

We are indebted to the scientific and successful enquiries of Mr. Sowerby, for the formation of the following genera, in addition to *Cirrus*, *Plagiostoma*, and *Euomphalus*, which have been already noticed:—

Dianchora.—An attached, inequivalved bivalve; the attached valve having an opening instead of a beak, the other beaked and eared; hinge without teeth. *Pl.* VII, *fig.* 11.

Productus.—An equilateral, unequal valved bivalve, with a reflexed, more or less cylindrical margin; hinge transverse, linear; beak imperforate; one valve convex, the other flat or concave, externally. Fossil. *Pl.* VII, *fig.* 13.

This genus was formed, by Mr. Sowerby, for the reception of those fossils which had been placed, by Mr. Martin, under *Conchyliothus (Anomites) Scabriculus*, Petrif. Derb.; and, of others, which he had obtained from the limestone which forms a part of the independent coal-formation of the Lothians, Scotland.

The characters and classification of the shells of this family are not, however, yet determined: with the hope, therefore, of leading to more decisive information respecting these points, the structure of the hinge, as existing in a shell bearing the external appearance of one of this family from the mountain limestone of Shropshire, with which the writer was favoured by the Rev. Mr. Hallifax, of Standish, in Gloucestershire, is shewn, *Pl.* IX, *fig.* 9.

Magas.—An inequivalved, equilateral bivalve; one valve with an angular sinus along an incurved beak; line of the hinge, and back of the other valve, straight, with two projections near the middle. A partial longitudinal septum, with appendages, are attached to the hinge within. Fossil. *Pl.* VII, *fig.* 14.

Spirifer.—An equilateral, inequivalved bivalve; the valves beaked; one valve with a large angular sinus along the inside of the beak; hinge transverse, long, and straight; two spirally-coiled tubular appendages nearly filling the shell. Recent. *Pl.* VII, *fig.* 15.

Astarte. Suborbicular or transverse; ligament external; lunette on the posterior side; two diverging teeth near the beak. Fossil. *Pl.* VIII, *fig.* 1.

Inoceramus.—An inequivalved, inequilateral bivalve, slightly eared; hinge formed of alternate ridges and furrows on the margin of the eared part; the substance of the shell spathose, vertically striated. Fossil. *Pl.* VIII, *fig.* 23 *.

Pentamerus.—An equal-sided, inequivalved bivalve; one valve divided by a longitudinal, internal septum into two parts; the other, by two septa, into three parts or valves; the beaks incurved, imperforate.
Fossil. *Pl.* X, *fig.* 7.

☞ The figure, intended to illustrate the genus *Pholas*, page 177, will be found in *Pl.* VIII, *fig.* 25.

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* I have placed this shell among those, for the name and description of which, I believe, we are indebted to Mr. Sowerby, although I have not yet been able to ascertain in what work his account of the genus is to be found.

A List of the Species of Fossil Shells particularised by Le Chev. de Lamarck, in *Les Annales du Museum,* and *Histoire Naturelle des Animaux sans Vertebres;* with a specification of their most distinguishing characters.

Note.—When the size of the shell is mentioned, it is to be taken as generally meaning the larger size: by *small,* is meant less than half an inch; and, by *very small,* less than a quarter of an inch.

Chiton.

Grignonensis: octovalvis?

Patella.

elongata: obtusely radiated, apex much inclined.
dulcis: subconical, apex inflected.
scutatella: very small, apex central.
dilatata: rugose, depressed.
cornucopia: obliquely conical, impression semicircular.
spirostris: rudely striated.
retortella: spire obliquely lateral.
pennata: subimbricated posteriorly.
squamæformis: flattish and smooth.

Fissurella.

labiata: subsquamose, striæ decussating.

Emarginula.

costata: ribbed longitudinally, apex hooked.
clypeata: cancellated, back grooved.
radiola: with radiating costulæ.

Calyptræa.

trochiformis: echinated, apex subcentral.
crepidularis: subovate: var. of former?

Conus.

antediluvianus: long, spire pointed, wreaths crenulated.
deperditus: spire not much raised, the wreaths not crenulated, but grooved on the top.
turritus: subfusiform, whirls oblique.
stromboides: spire obtusely nodose, whirls obtuse.
antiquus: dilated upwards, lip bowed, spire smooth, slightly canaliculated—3½ inches.
Betulinoides. oblongo-conical, smooth, spire convex, pointed, base rounded—4 inches.
clavatus. conico-clavated, striæ longitudinal and bowed, spire elevated, rather pointed, wreaths convex—3 inches.

Conus, *continued.*

intermedius.: smooth, base transversely sulcated, spire acutely convex, wreaths not striated—2⅛ inches.
avellana.: short, base substriated, spire rather convex and pointed —1 inch.

Cypræa.

pediculus: transversely striated.
inflata: smooth, obscurely marginated.
leperina.: ventricose, submarginata, opening dilated at the base—1¾ inch.
mus.: the perfect analogue of the recent shell known by this name.
pyrula.: obtuse, narrowed behind, lip bordered—1¾ inch.
utriculata.: inflated, subumbilicated, lip obsoletely marginated—1⅛ inch.
rufa.: agrees with the recent shell of the same name.
antiqua.: ventricose, rough, rather flat beneath, opening narrow—1¼ inch—*Ronca*.
ruderalis.: ovately oblong, rough, obsoletely marginated on the sides —1 inch—*Ronca*.
fabagina.: subventricose, obscurely marginated on one side—¾ inch.
flavicula.: ventricose, marginated on one side, back yellowish, with white spots—1 inch.
ambigua.: contracted at the extremities, convex beneath, opening winding—¾ inch.
colombaria.: one lip marginated, rather projecting forwards—¾ inch.
dactylosa.: oblong, ventricose, rather cylindrical, obtuse, sulcated transversely, no flattening on the under surface, no longitudinal groove on the back, spire not apparent—1½ inch.
C. sulcosa of Les Annales du Mus.
sphæriculata.: transversely sulcated, no dorsal groove, lip marginated.
coccinella.: variety of the preceding?
pisolina.: pisiform, back smooth; opening curved, plicatedly dentated —½ inch.
ovulata.: obtuse in the fore part, smooth; columella obsoletely dentated.

Ovula.

passerinalis.: smooth, scarcely beaked, lip lightly bowed—¾ inch.
birostris.: exterior lip marginated, columella with an oblique fold—1 inch.

Terebellum.

convolutum[*]: subcylindrical, no spire, opening the length of the shell —1¼ inch.
fusiforme: spire extremely obtuse, opening shorter than the shell—2¼ inches.

Oliva.

canalifera: callus of the columella having a canal.
mitreola: columella striated.
Laumontiana: columella biplicated.

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[*] *Bulla sopita*, Brand, Foss. No. 29.—*Bulla voluta ejusdem*, No. 75.

Oliva, *continued*.

plicaria: long, spire pointed, rather short; columella longitudinally plaited---1 inch.

clavata: spire prominently pointed, columella with numerous striæ---¾ inch.

Ancilla.

buccinoides: margaritaceous.

subulata: spire elongated.

olivula: unidentated at the base.

canalifera: canal between the right lip and the spire.

glandiformis: subventricose, rather pointed at the summit, callous in the lower part, sutures of the whirls concealed---2 inches.

Voluta.

harpa: longitudinal ribs with two spines at their tops, five folds on the columella---3½ inches.

*spinosa**: subcostated; short, pointed spinous spire; four or five folds—1½ inch.

musicalis: longitudinal ribs with one spine, four large folds---3 inches.

muricina: ribbed and spinous in the upper part, smooth and caudated in the lower, deeply grooved between the four columellar folds—3½ inches long.

costaria: elongated, fusiform, subcaudated, ribs plain, longitudinal—2½ inches.

lyra: spire short; plain longitudinal ribs, denticulated towards the apex---2 inches.

bicorona: ribbed longitudinally, no transverse striæ; turns of the spire bicoronated---2 inches.

crenulata†: ribs crenatedly granulated---1½ inch.

harpula: finely ribbed, the ribs smooth, whirls subcanaliculated, two very strong folds—1½ inch.

labrella: ovate, subventricose, wreaths sharply carinated, spire denticulated—1¾ inch.

depressa: ribbed upwards, base transversely grooved, spire subcoronetted, columella flat—about 1½ inch.

variculosa; with a marginal and sometimes a dorsal varix; four slight folds—about ¾ of an inch.

mitreola: lip obsoletely bidentated.

heteroclita: base smooth, spire ribbed, rather tuberculated, columella with the smallest plaits upwards, as in *Mitra*---2½ inches.

digitalina: decussated, subgranular, spire short---1 inch---perhaps a variety of *V. crenulata*.

clathrata: subcoronetted, cancellated, columella with numerous plaits---1½ inch.

ambigua‡: transversely striated, longitudinally ribbed, spire subdenticulated, lip sulcated internally, the lower folds on the columella the largest---1½ inch.

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* *Strombus spinosus*, Brand, Foss. No. 65.

† *Murex suspensus*, Brand, Foss. No. 70.

‡ *Strombus ambiguus*, Brand, Foss. No. 69.

Voluta, *continued*.

ficulina: transversely striated, last wreath crowned with spines, lip submarginated, striated inside, and bowed at the top—2 inches.

rarispina: with two or three dorsal spines, lip rather bordered, spire small, with five or six dentelated turns—1½ inch.

Mitra.

crebricosta: ribs obsolete in the lower part, four folds—½ inch.

monodonta: smooth, but striated in the upper part—small.

marginata: a crenulated border on each turn.

plicatella: margin of the turns subplicated—¾ inch.

labratula: ribs decussated with transverse striæ—½ inch.

mixta: resembles *marginella*, but has the folds of the mitres—¾ inch.

cancellina: lip internally striated.

terebellum: narrow, fusiform—small.

fusellina: smooth, base striated—small.

graniformis: longitudinally ribbed—very small.

mutica: no striæ on the spiral wreaths, four folds—1 inch.

elongata: fusiform, smooth, five folds—2 inches.

citharella: distant longitudinal ribs, four folds, no left lip.

Marginella.

eburnea: spire conoidal, the borders of the turns confluent.

dentifera: smooth, spire subpyramidal.

ovulata: lip grooved internally, four folds—½ inch.

Cancellaria.

costulata: longitudinal, decussated, ribbed, three folds—½ to ¾ inch.

volutella: with the varices of a *murex*, the folds of a *volute*, and the notch of a *buccinum*—¾ inch.

Purpura.

lapillus[*]: acutely ovate, ribs transverse, lip subdentated.

Buccinum.

stromboides: oblongo-ovate, smooth, a groove between the right lip and spire—2 inches.

striatulum: the turns rounded, striæ transverse—small.

terebrale: long, smooth, rather turriculated—½ inch.

decussatum: the whirls convex; opening subdentated—½ inch.

bistriatum: striæ alternately larger and smaller, a slight border on the lip—1 inch.

clavatulatum: long, lip emarginated in the upper part—very small.

Terebra.

plicatula: the last turn smooth, the rest plaited—1 inch.

scalarina: longitudinally ribbed, turns convex—1 inch.

Harpa.

mutica: ribs plain, not pointed; decussating intercostal striæ—1 inch.

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[*] *Buccinum lapillus*, Lin.

Cassis.

harpæformis: ribs longitudinal, with a transverse row of tubercles at their upper part—2 inches.

cancellata: with two rows of tubercles, lip dentated.

*carinata**: with five carinated girdles, the upper tubuculose.

Strombus.

canalis: longitudinally ribbed; the lip notched.

Rostellaria.

macroptera†: lip large and round, running up the spire—from 6 to 7 inches.

colombaria: lip alæform, bent upwards on the spine—2 inches.

fissurella: longitudinally ribbed; lip small, passing up the turns and forming a groove—1¼ inch.

Murex.

tripterus‡: trigonal, with angular, winged, membranaceous processes—2 inches.

tricarinatus: ovato-oblong, with curled, frondose, subspinous processes—1½ inch.

contabulatus: spire long, subpyramidal; mouth subtrigonal—var.?

calcitrapa: ovate, frondose ridges, terminating in points; columella subumbilicated.

crispus: ovate, with about nine frondose but not spinous ridges; the mouth and canal short—¾ inch.

frondosus: ovate-oblong, with about nine curled frondose varices; the canal rather long—¾ inch.

clathratus: ovate, ribbed, sulcated transversely, lip dentated, canal short—very small.

cingulatus: ovato-oblong; transverse encircling rugæ, squamose between; canal covered over—1½ inch.

striatula: oblong, with transverse striæ, and but few longitudinal convex ribs; lip dentated—¾ inch.

cancellinus: ovato-oblong, cancellated; opening winding and toothed: resembles the white *grimace*.

pyraster: ovate, caudated, transversely sulcated, with subnodulous ribs; the opening rounded; grooved internally—1¼ inch.

textiliosus: ovate, obsoletely ribbed, transversely striated, squamous between; one tooth on the columella; subumbilicated—1½ inch.

colubrinus: elongated, subfusiform; with fine transverse granular striæ; few varices—1 inch.

viperinus: elongated, with transverse striæ slightly granulated; tail small; very small indistinct ribs on the upper part—¾ inch.

nodularius: ovate, subcancellated; transverse nodular striæ, the nodules disposed in ribs; the tail short and curved outwards—1 inch.

reticulosus: ovate, pointed at both ends, reticulated; opening triangular; lip toothed—small.

tubifer: ovate, pointed; four rows of ridges; with fistulous, bowed, erect spines, with short tubes between.

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* *Buccinum nodosum*, Brand, Foss. No. 131.

† *Strombus amplus*, Brand, Foss. No. 76.

‡ Brand, Foss. No. 79 and 80?

Fusus.

rugosus *: long, subcancellated; spire nodular; canal long, straight, and nearly covered over—3 inches.

Noæ: long, transversely striated; the top of each whirl depressed and plicated—3½ inches.

longævus †: long, thick and smooth; last turns rather flat on their tops; spire nodular, striated—4 inches.

clavellatus ‡: fusiformly clavellated; transversely striated; ribs nodular; tail very long; turns of the spire not flat.

aciculatus §: fusiformly linear, very narrow striæ with decussating plicæ: different from *F. rugosus*—1¼ inch.

subulatus . longitudinally ribbed; tail shorter than the spire—¾ inch.

hordeolus: fusiformly turriculated; tail short—very small.

intortus: subcancellated in the upper part, in the lower the transverse striæ most evident; columella as if twisted—1½ inch.

polygonus: ovate, with many ribs; transversely rugose; the edges of the turns raised against the preceding; opening dentated—1¼ inch.

abbreviatus: ovato-conical, rugous transverse rings; nodose ribs; columella obsoletely umbilicated—½ inch.

excisus: columella as if cut obliquely—¾ inch.

minutus: ovate, ribs numerous; transverse striæ united in bands—very small.

asperulus: ovate, turreted, ribbed, rough transverse striæ; canal short—small.

plicatus: ovate, turreted; ribs smooth, longitudinal; base short; no transverse striæ—small.

scalaroides: numerous distinct fine ribs, obsolete transverse striæ; canal short—¾ inch.

coronatus: ovate, conical both ways; spire crowned with numerous small nodules, lower half finely striated—small.

alligatus: ovate, turreted, prominent, transverse rugæ; canal short—small.

marginatus: fusiform, turreted; spire nodulous, and the upper edge of each turn raised—small.

nodulosus: ovate, small, nodulous ribs; columella obliquely biplicated.

angulatus: fusiform, ventricose; thick, acutely angular ribs; transverse, prominent striæ—1 inch.

uniplicatus: rough, with ribs and decussating striæ; columella with one plait—1¼ inch.

funiculosus: long, fusiform; transverse rugæ, alternating in size; columella slightly plaited—1¼ inch.

heptagonus: seven rows of ribs with decussating striæ; columella rather plaited—nearly 2 inches.

subcarinatus: ovate, short and turgid ribs, angular at their ends; turns carinated angularly, flattish at their tops.

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* *Murex porrectus*, Brand, Foss. *fig*. 35.

† *Murex longævus*, Brand, Foss. *fig*. 40, 73, 93.

‡ *Murex deformis*, Brand, Foss. *fig*. 37, 38.

§ *Murex*, Brand, Foss. *fig*. 36.

Fusus, *continued.*

ficulneus: ovate, almost globular; about fifteen ribs like folds, forming at about two-thirds of their length a row of tubercles across the shell; the base bowed; columella twisted, with an oblique fold—1 inch.

Pyrula.

lævigata: obovate, very thick, especially on the left side; obtusely striated, the spire pointed—2 inches.

subcarinata: smooth, back obtusely carinated; turns concave upwards; spire pointed.

tricarinata: clavated, last turn decussated and with three transverse prominent distant striæ—1¼ inch.

elegans: decussated, the transverse striæ raised and undulating.

clathrata: ovately clavated, decussated, the transverse striæ alternately large and small.

*nexilis**: ovately clavated, decussated, the transverse striæ largest.

bulbiformis†: ovate, ventricose, rather smooth; spire hooked; tail rather bowed; the left side thickened as by a callus on the columella—2½ inches.

terebralis: girt with transverse and granulated striæ; whirls dentatedly carinated, spire like a screw—small.

citharellus: turreted, with smooth narrow ribs; base short—small.

lævigatus: fusiform and turreted; spire smooth and conical, with a mammillary termination.

striatulus: fusiform and turreted; the turns flat on their tops and sides, with very fine equal striæ—very small.

biplicatus: ovate, transversely striated; longitudinal ribs; columella with two folds—very small.

variabilis: many ribbed, turns subangular—small.

truncatulatus: ovate and turreted, the margins of the spiral turns truncated, the spire plicated—small.

Pleurotoma.

filosa: ovato-fusiform, lip alæform—1½ inch.

lineolata: ovato-fusiform—var.?

cluvicularis: fusiform, turreted, whirls bordered with striæ on the upper part, lip alated—2 inches.

glabrata: fusiform, base transversely grooved—1¼ inch.

marginata: turns bordered upwards by a cord-like margin, and separated by two or three grooves with sunk points.

transversaria: fusiform, deeply grooved transversely, whirls carinated—2½ inches.

catenata: fusiform, decussated; the transverse striæ strongest, like a chain of tubercles on every turn—2 inches.

dentata: fusiform; a dentated keel on each turn—1½ inch.

undata: fusiform, turreted; whirls crenulated, with undulated ribs on their upper part, the tail short—1 inch.

multinoda: fusiform, turreted; whirls submarginated, nodulous in the middle—½ inch.

crenulata: fusiform, turreted; straight ribs, like cogs of a wheel on each whirl—¾ inch.

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* *Murex nexilis*, Brand, Foss. *fig*. 55.

† *Murex bulbus*, Brand, Foss. *fig*. 54.

Pleurotoma, *continued.*

bicatenata: fusiform, turreted; with two rows of nodes on the upper part of the whirls—¾ inch.

costellata: oval, fusiform; whirls with longitudinal ribs—½ inch.

plicata: fusiform, turreted; whirls with rather curved plaits—small.

sulcata: fusiform, turreted; decussated in the lower part; whirls with longitudinal ribs—small.

curvicosta: ovato-fusiform; bent ribs, as if split or bifid at their tops—¾ inch.

furcata: whirls, with ribs contracted above their middle, and forked underneath.

nodulosa: ovato-fusiform; spire pyramidal, with nine rows of short nodulous ribs—¾ inch.

ventricosa: ovato-fusiform, ventricose and caudated—¾ inch.

terebralis: fusiform, with transverse granulated striæ and dentated keels—½ inch.

granulata: subturreted, granulated, base short—½ inch.

inflexa: subturreted; spire long, plaits separate in their middle, a granulated keel—small.

turrella: subturreted; the whirls carinated; spire tuberculated in the upper part—small.

striarella: fusiform, turreted, almost smooth, plaits and striæ hardly discoverable—small.

decussata: fusiform, turreted; spire small, long, and nodulous, with two rows of tubercles, one small the other large—½ inch.

Cerithium.

interruptum: pyramidal; transverse striæ in rows, alternately large and small; ribs bowed, last turn ventricose—1¾ inch.

hexagonum: with five or six longitudinal ribs; last whirl tumid, with five or six spinous tubercles—2 inches.

serratum: turreted, echinated; two rows of compressed teeth on each turn, the lower smallest; four internal plaits on right side—2½ in.

tricarinatus: pyramidate; three denticulated keels, the lowest by much the largest—2 inches.

vittatum: turreted; upper whirls smooth, lower ones with three tuberculated bands—2 inches.

clavatulatum: rough, with transverse tubercular keels, three at the upper part, and decreasing to one on the lowest turn; notched like a *pleurotoma*—1½ inch.

echinoides: rather heptagonal, with tubercles a little pointed, in two or three rows; twelve or fourteen turns, sometimes orange coloured—1¼ inch.

angulosum: pyramidate, twelve turns, with transverse striæ, and a central angulated keel, points at the angles—1½ inch.

cristatum: turreted; whirls with a dentated keel in the middle; the base transversely sulcated—1¼ inch.

calcitrapoides: turreted, with transverse muricated ribs, no striæ—1½ inch.

denticulatum: spire subulated and smooth at the top, the other whirls denticulated with points in their upper parts, and striated beneath—¾ inch.

Cerithium, *continued.*

umbrellatum: the upper margins of the whirls denticulated, the under ones crenulated and expanded in the teeth of the next whirl, no striæ, top of the spire smooth—1¼ inch.

lamellosum: turreted, subplicated; distant transverse striæ, base with three transverse lamellæ—1½ inch.

thiara: turreted, rather cylindrical; whirls crowned with tubercles, flat beneath; the lip alated—¾ inch.

mutabile: three transverse striæ on each whirl, the lower whirl with the upper stria tuberculated stronger than the others, upper whirl with the striæ all alike—1¼ inch.

semicoronatum: turreted; three granular striæ on each whirl, the uppermost thickest; a plait on the columella—1¼ inch.

cinctum: conical, turreted; three granular striæ, rather equal in size; a plait on the columella—1¾ inch.

plicatum: turreted, subcylindrical; whirls granulated longitudinally—1 inch.

conoideum: short, conoidal, three or four rows of granulæ on each whirl—1½ inch.

confluens: turreted, with three transverse granulated keels, the lowest the largest, granulæ confluent—¾ inch.

clavus: subulate; two or three transverse granular striæ, vertically confluent; base short and twisted—¾ inch.

baccillum: subulate, with eight or nine unequal obscure granular striæ—¾ inch.

scabrum: pyramidate; echinated with two dentated keels, the lower the largest—¾ inch.

asperellum: conical, with two dentated keels, teeth very small—var.?—small.

turritellatum: turreted; whirls convex, with three transverse striæ, and vertical bowed ribs—1 inch.

mitra: conical, with four vertical striæ, crossed by small granular ribs—small.

pleurotomoides: conical, turreted, with two rows of obtuse tubercles; a notch in the right lip—small.

involutum: conical, turreted; turns smooth, imbricating; columella twisted—1 inch.

tuberculosum: turreted; two rows of tubercles, the upper largest, the lower margins crenulated—1¼ inch.

bicarinatum: turreted, with subangulated keels; four transverse striæ at the base—¾ inch.

trochleare: conical, subturreted; two transverse keels, raised and dentated, crossed by vertical ribs, giving an alveolated appearance—small.

trochiforme: conical, short; striæ obsolete; longitudinal ribs—very small.

muricoides: conical, ventricose; tubercular and granular striæ; whirls convex—½ inch.

purpura: conical, short; transversely striated, and distinctly tuberculated—var.?—½ inch.

conoidale: short; the whirls flat, with unequally truncated and subtubercular striæ—small.

subulatum: turreted, with noduliform ribs and transverse obsolete striæ; opening oblong.

Cerithium, ***continued.***

lapidorum: turreted; whirls convex, subtubercular in the middle; bowed vertical ribs, nearly obsolete—1¼ inch.

petricolam: turreted, smooth, with a thick border on the upper part of the whirls, transversely grooved beneath—1 inch.

spiratum: round, turreted, smooth; turns flat and channelled in the upper part; base with one groove, plicated outwardly—2½ inches.

columnare: subulate, transverse and vertical striæ decussating, with a marginal groove beneath the upper margin—1 inch.

substriatum: conical, turreted, almost smooth; the lower whirls with simple distinct striæ, the upper with obsoletely crenulated ones—1 inch.

quadrisulcatum: subulate, turreted; turns flat, with four grooves—¾ inch.

umbilicatum: subulate; whirls flat with four transverse grooves; the columella umbilicated—⅓ inch.

perforatum: subulate; whirls rather convex, finely striated; columella perforated—½ inch.

clavosum: smooth, turreted, with obsolete striæ; the lower whirls involving the upper—½ inch.

cancellatum: subulate, turreted; cancellated whirls convex; columella subplicated—small.

semigranosum: turreted, decussated with subgranulated crossing striæ; canal very short—⅓ inch.

acicula: subulate, smooth; whirls subcarinated—⅓ inch.

terebrale: turreted, smooth convex; whirls with obsolete transverse striæ—small.

inversum: turreted, subulate, left-turned; the whirls cancellated by transverse keels and suboblique vertical striæ—¾ inch.

melanoides: oval, turriculated, with transverse striæ; opening much like that of *melania*—very small.

larva: turreted, cylindrical; whirls with two equal transverse granular keels—very small.

gracile: turreted and subulate; whirls inversely imbricated—small.

incertum: turreted; whirls convex, with distant transverse striæ and more numerous vertical ones.

emarginatum: turreted, transversely sulcated, upper grooves granulated, upper borders of the whirls subcanaliculated; the lip notched—2 inches.

rugosum: turreted, upper whirls decussatedly granulated, the lower slightly sulcated with one groove, lowest rugous beneath—1½ inch.

giganteum: turreted, very long; transversely striated; whirls nodose upwards; columella with one plait; opening oblong, oblique, with a canal which rather terminates backwards; upper part of the right side with a lateral auriform elongation.

nudum: turreted; whirls plicated in the upper part, numerous transverse striæ; no plait on the columella—3 inches.

unisulcatum: turreted, numerous transverse striæ, no plicæ; the turns have a single, nearly central groove—½ inch.

turritellatum: turreted; convex whirls with transverse unequal striæ; a notch in the right border of the opening—small.

Trochus.

crenularis: pyramidate, transversely tuberculated, the lower margins of the whirls thickly crenated with large tubercles; columella truncated—1 inch.

Resembling *trochus mauritianus.*

monilifer: conical, imperforate, transversely granulated in four rows; columella obliquely subtruncated; eight concentric rows of grains on the base—¾ inch.

sulcatus: conical, subperforated, transversely and elegantly grooved; the lower margin prominent. Analogous in some respects with *T. granulatus* and *conulus*—½ inch.

alligatus: conical, imperforate, spotted; whirls flat, with six unequal lines, lowest thickest—½ inch.

ornatus: conical, imperforate; whirls with numerous oblique ribs on their upper part, on the lower two rows of small tubercles—¾ inch.

subcarinatus: abbreviated, conical; whirls smooth, the inferior borders forming an obtuse keel; base rather convex, finely striated circularly, and perforated—not ½ inch.

bicarinatus: conical, imperforate; whirls smooth, with two distant keels.

*agglutinans**: conical, depressed, dilated at the base; whirls rude, polyëdral; umbilicus internally plaited.

Solarium.

patulum: convex, with smooth whirls, with carinated and crenulated borders; umbilicus open—¾ inch wide.

sulcatum: convex, with radiating grooves beneath; whirls smooth with a doubly-grooved border; umbilicus concave, with crenulated margins—¾ inch.

canaliculatum: convex, with transverse grooves formed between strings of grains; umbilicus crenated and canaliculated—½ inch.

plicatum: convex, depressed, rugous, vertically sulcated; umbilicus crenated with large plicæ—nearly ½ inch.

spiratum: conoidal, smooth, substriated; whirls flat, subcanaliculated and crenulated in the upper part; umbilicus granulated and crenulated within.

ammonites: depressed, discoidal; turns flat, with sulcated vertical rugæ; umbilicus open, crenated—very small.

patellatum: depressed, discoidal, carinated; turns flat, except on their borders; a platter-formed umbilicus; margin subcrenulated—very small.

disjunctum: discoidal, carinated, smooth; spire flat, lower surface convex, the last whirl disjoined; umbilicus serrated.

bifrons: discoidal, obtuse, smooth, spire sunk; opposite side also subumbilicated, the last turn including the rest—very small.

Turbo.

squamulosus: conoidal, pointed, umbilicated; whirls convex, with five squamose grooves—not ½ an inch.

radiosus: globosely conoidal, five whirls deeply sulcated in the middle, above and below radiately striated—small.

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* *Trochus umbilicaris,* Brand, Foss. *fig.* 4 and 5, *non* Linnæi.

Turbo, *continued.*

helicinoides: depressedly conoidal, polished, a little spotted; four whirls, smooth; base rather callous.

Resembles *troch. vestiarius*, Lin.

denticulatus: globosely conoidal, transversely striated; whirls four, with two denticulated keels in the middle; base umbilicated—very small.

Delphinula.

calcar: spire depressed; whirls rough, keeled in the middle, keel armed with spines—nearly 1 inch wide.

lima: orbiculato-convex, rough, transversely striated, echinated with concave squamous striæ; whirls round, but subangulate—¾ inch.

conica: conically pyramidal; whirls smooth but bicarinated, last turn disjoined—small.

turbinoides: obtusely conical, whirls obsoletely keeled, with minute striæ—small.

marginata: roundish; whirls smooth, umbilicus lessened by a border—small.

striata: roundish, transversely striated; whirls subangular; umbilicus spiral—very small.

sulcata: roundish, depressed; whirls deeply sulcated, lip serrated—very small.

canalifera: roundish; smooth; margin of the umbilicus plaited; a canal passing spirally up its sides—very small.

Cyclostoma.

cornupastoris: orbiculato-convex; transversely striated, whirls round, detached at the base—very small.

spiruloides: orbicular, smooth, pellucid—very small.

planorbula: round, solid, umbilicated beneath—very small.

macrostoma: orbicular, pellucid, mouth very open—minute.

mumia: cylindraceo-conical; solid, longitudinal and transverse striæ; opening ovate—¾ inch.

turritellata: turreted; turns convex, with decussating striæ—very small.

Planorbis.

nitidula: smooth; polished; opening round—very small.

subangulata: obsoletely carinated; opening round but rather angular—very small.

bicarinata: transversely striated; bicarinated.

spirorbis: belongs, perhaps, to *Delphinula.*

Scalaria.

crispa: turreted; ribs numerous, subangulated at the base; whirls ventricose—½ inch.

decussata: turreted; long, transversely striated; ribs longitudinal; whirls contiguous—¾ inch.

denudata: turreted, ribs few, whirls distant—¾ inch.

monocycla: conical, whirls contiguous, a raised stria on the base of the last turn—¾ inch.

plicata: turreted, small plicæ-formed ribs.

Turritella.

imbricataria: subulated; whirls flat, imbricated, transversely striated, finely granulated intermediately—3 inches.

sulcata: conical, transversely sulcated, lowest grooves deepest, fine vertical bowed striæ—2 inches.

subcarinata: conical, transversely sulcated, grooves unequal; separated by keels—1 inch.

fasciata: conical; two grooves in the upper part of the whirls; a flat zone in the middle divided by a fine striæ—¾ inch.

multisulcata: conical, whirls convex, numerous; nearly equal grooves —1 inch.

terebellata: long, subulated, whirls subconvex, striated, with small interstitial whirls—5 inches.

perforata: subulated, whirls flat and imbricating, with three transverse striæ and a raised margin; columella perforated through its whole length—1 inch.

unisulcata: subulate; smooth flat whirls, one groove at the lower margin—1 inch.

uniangularis: conical, subulate, one transverse angle in the middle of each whirl—½ inch.

melanoides: conical, whirls flat with transverse striæ and grooves intermixed—½ inch.

There exist numerous varieties of these species.

Bulla.

ovulata: transversely striated, spire involved—½ inch.

striatella: short, finely striated; spire obtuse, upper edges of each whirl carinated—small.

cylindrica: striæ chiefly on the base, vertex umbilicated—½ inch.

coronata: oblong, subcylindrical vertex umbilicated, the margin coronetted.

Bulimus.

albidus: ovate, smooth, whirls rather convex; opening semiovate. Seems not to be fluviatile—½ inch.

citharellus: ovate conical; transversely striated, longitudinal ribs, apex papillated—very small.

Marine? Auricula?

terebellatus: turreted, umbilicated, very smooth, opening oval, angular at both sides—¾ inch.

acicularis: turreted, long, thin—small.

nitidus: turreted, very smooth, whirls rather convex, lip sharp—small.

sextonus: turreted, six smooth convex whirls, opening ovate—small.

conulus: conical, upper part of the whirls channelled, spire acute—very small.

clavulus: whirls flat, striæ transverse—very small.

striatulus: whirls convex, very finely striated—very small.

nanus: whirls convex, with very small vertical plicæ—very small.

Several other shells are placed, doubtfully, under this genus, which are hardly distinguishable from *turbo*, *cyclostomus*, &c.

Phasianella.

turbinoides: ovate; variously coloured, whirls smooth—½ inch.

Lymnæa.

palustris.· oblong, substriated, with rather convex whirls, opening ovate.

Melania.

costellata.· turreted, subulate, transversely striated, the upper part of the lip channelled within—1 inch.

lactea.· turreted, thick whirls convex, lower, smooth; upper striated vertically—1 inch.

marginata.· conical, turreted, striæ transverse, distant, whirls subcanaliculated in the upper parts, opening bordered—1 inch.

hordacea.· turreted, striæ transverse; opening small—small.

canalicularis: turreted, subulate, whirls convex, with fine transverse striæ—small.

corrugata.· turreted, whirls decussated on their upper parts—¾ inch.

semiplicata.· conical, transversely striated, vertically subplicated; opening with a produced sinus—¾ inch.

nitida.· subulate, pointed, whirls smooth and shining—½ inch.

semistriata.· upper whirls vertically striated; lower ones smooth—small.

cochlearella.· with small long grooves; lip produced somewhat like *cerithium*—½ inch.

fragilis.· convex whirls, longitudinal grooves—very small.

dubia.· ovato-conical; ribbed vertically, striæ small and transverse; columella truncated—small.

Auricula.

sulcata.· ovato-conical, transversely sulcated; spire acute; columella with one plait—¾ inch.

ovata.· ovato-acute, subventricose smooth; lip bordered internally; columella subtriplicated—½ inch.

ringens.· ovato-acute, rather turgid; transversely striated; lip bordered with a callous margin; columella subtriplicated—very small.

miliola.· ovato-conical; smooth, columella with one fold—very small.

hordeola.· ovato-conical, smooth; lip striated within; columella with one fold—small.

acicula.· turreted, subcylindrical, smooth; columella one fold—small.

terebellata.· turreted, smooth, opening semiovate; columella with three folds—small.

Volvaria.

bulloides.· cylindrical, transversely striated; spire pointed and nearly included—¾ inch.

Ampullaria.

pygmæa.· ventricose, smooth; base umbilicated; aperture long—very small.

excavata.· ventricose, smooth; columella with a sinuous excavation—small.

conica.· ovato-conical, whirls smooth and convex; umbilicus half covered—¾ inch.

acuta.· ventricose, spire short and pointed; umbilicus half covered—1 inch.

Ampullaria, *continued.*

acuminata.· ventricose; spire long and pointed; umbilicus covered.
spirata.· subventricose; whirls flat on the top, with an acute border.
depressa.· globose, turns convex on the upper part; columella depressed in the lower part—1 inch.
canaliculata.· globose; spire short and canaliculated; a spiral groove accompanying the umbilicus—½ inch.
*patula**.· ventricose; spire short; umbilical groove covered over; lip wide, subauriculated—1½ inch.
sigaretina.· ventricose, imperforate; spire short; lip large—1½ inch.
crassatina.· globose, thick, imperforate; base of the columella spread out; spire canaliculated—3 inches.
hybrida.· globose, imperforate; columella effused—1½ inch.

Serpula.

intorta.· rather angulated, contortedly agglomerated, plicæ transverse.
cristata.· round, with denticulated ribs; contorted in a discoidal spire, the other end extended—France.
spirulæa.· compressed, smooth; discoidal spire, fore part disjoined, sharp edge—Bayonne.
minima.· capillary, glomerated—Grignon.
echinata.· flexuous, with subspinous ribs.
sulcata.· round, subglomerated, straight forward, numerous subdentated longitudinal folds—Touraine.
costalis.· angulated, loosely contorted, base subspirated. smooth, longitudinal.
dentifera.· round, contorted, with two or three dentiferous longitudinal folds—Italy.

Balanus.

sulcatus.· conical, obtuse long grooves; radiating transverse striæ.
tintinnabulum.· conical, subventricose; longitudinally lineated, transverse striated rays; rostrated backwards—Italy.
cylindraceus.· narrow base, elongated, subventricose—Turin.
miser.· gregarious, short, valves straight, back in the lower part with two or three grooves; opening dilated; valves of operculum pointed—Italy.
pustularis.· short, subconical; valves smooth, six rays, two solitary, the rest in pairs—Piedmont.
crispatus.· conical; five distinct rays; valves naked at the apex, muricated at their base—Italy.

Clavagella.

echinata.· ventricose, echinated all over; on one side with tubular spines—Grignon.
Fistulana echinata, Ann. du Mus. Tom. VII, p. 429, *Pl.* XII, *fig.* 43.
cristata.· a crest of tubular spines on one side—Grignon.
tibialis.· naked, compressed; valve discoverable—Grignon.
Brocchii.· pyriform, set with short tubes—Italy.

Fistulana.

ampullaria: sheath ampullaceous, produced, opening bicarinated—Grig.
pyrum.· sheath pyriform, plain—Italy.

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* *Helix mutabilis,* Brand, Foss. No. 51.

Teredina.

personata .· straight, sinus and lobules like a mask—Courtagnon.
baccillum .· solid, straight, and round—Italy.

Solen.

vagina .· linear, straight; one tooth—Grignon.
coarctatus .· oblong, transversely striated, contracted in the middle.
fragilis .· analogue of *solen cultellus ?*
effusus .· ovato-oblong, straight, smooth, subangulated forward. Somewhat resembling *solen vespertinus.*
strigilatus .· ovato-oblong, with oblique imbricating striæ.
appendiculatus .· elliptical, smooth; an appendicular part at the base —small.

Glycimeris.

margaritacea .· ovate, truncated forwards—Grignon.

Lutraria.

solenoides .· transverse, rugæform striæ; foreside very long; apex rounded, gaping much—Mount Marius.
elliptica .· transverse striæ—very small—Bordeaux.
crassidens .· solid, opaque, substriated; cardinal tooth thick.

Mactra.

deltoides .· ovato-trigonal, shorter behind; elegantly plicated by the corselet and lunule—Grignon and Bourdeaux.

Crassatella.

tumida .· ovato-trigonal; gibbous and thick with age; the foreside angulated; base transversely sulcated; margin dentated within.
sinuata .· obliquely trigonal; foreside angulated, winding—Bordeaux.
striatula .· ovato-trigonal, with numerous fine transverse grooves or striæ—St. Brieux.
compressa .· ovato-orbiculate, rather flat; angulated forwards; transverse striæ, most prominent at the base—Grignon & Courtagnon.
lamellosa .· transversely oblong, with distant erect lamelliform ridges; valves crenulated—Grignon.
trigonata .· orbicularly trigonal; transversely grooved; base rather smooth; border smooth—Grignon.
latissima .· elliptical, compressed; unequally sulcated transversely; border smooth—Saint Iries.

Erycina.

lævis .· ovate, polished; striæ very fine, transverse; hinge with two teeth.
pellucida .· ovato-orbicular; with one very small tooth.
trigona .· ovato-triangular; one smooth tooth.
inequilateral .· obovate, tumid, smooth; two small teeth.
fragilis .· ovato-transverse; thin and pellucid; two teeth.
elliptica .· depressed in the middle; transverse striæ, very fine; two hinge teeth; pit intermediate.

Corbula.

gallica .· ovato-transverse; larger valve turgid, finely striated to the base, that being smooth—Grignon.
costulata .· the less valve with radiating longitudinal ribs; base smooth.
rugosa .· trigonal, ventricose; thick transverse grooves; angulated forwards, rather pointed—Grignon.
striata .· ovato-transverse; rather beaked, elegantly striated transversely—Grignon and Courtagnon.

Petricola.

chamoides .· ovate, inflated, thick; with longitudinal rugæ, curled and lamellated toward the margin on the upper side; the foreside widest—Italy.

Psammotæa.

solenoides .· oblongo-elliptical, smooth; base rather prominent; hinge about the middle, one teeth—Grignon.

Tellina.

patellaris .· elliptical, rather compressed; fine transverse striæ; hinge with two teeth—Grignon.
scalaroides .· rotundato-ovate; with transverse, fine, distant raised striæ; two teeth—Grignon.
rostralis .· oblongo-transverse, narrow; transversely sulcated; beaked on the foreside—Grignon.
zonaria .· ovate, flat; very finely striated transversely; brownish unequal zones, rather acutely angulated forwards.
patellaris .· approaches to *T. remies*, Lin.—1¾ inch—Grignon.
scalaroides .· ovato-elliptical; transverse striæ, raised, distant, and regular, like the steps of a ladder—1½ inch long—Grignon.
carinulata .· orbiculato-elliptical, rounded at both sides; rather remote, elevated and carinated striæ.
sinuata .· ovato-elliptical, short and obtuse forward; a depression on the disk rendering it sinuous; striæ transverse, very fine—Grign.
donacialis .· ovato-oblique, smooth; very short on the foreside, scarcely inflected; two wedge-like teeth, one grooved—Grignon.
rostralis .· oblongo-transverse, narrow, transversely sulcated; the forepart beaked, subbiangulated; two very small teeth on one valve, and one on the other—Parnes and Grignon.
corneola .· ovate, subpellucid, angulated forwards; very small transverse striæ.
pusilla .· ovate, pellucid, smooth, with an oblique small pit added to the hinge tooth—Grignon.
rudis .· oblongo-ovate, transverse, rather smooth; the foreside obtusely angulated—Grignon.

Corbis.

lamellosa .· transversely elliptical; cancellated, but on the posterior part, the lamellæ only dentated—Grignon.
petunculus .· round, ventricose; cancellated at the back part, the transverse lamellæ plaited and serrated—Granville.

Lucina.

mutabilis.· orbiculato-ovate, compressed radiating striæ inside the valve; the teeth lost with age. Two teeth, one divided, giving the appearance of three—3 or 4 inches—Grignon.

concentrica.· orbicular; rather flatly convex; raised concentric lamellæ, with minute longitudinal interstitial striæ, sometimes none—Grignon.

circinaria.· orbicular; subangulate forwards; very small transverse striæ; hardly any lateral teeth—Grignon.

columbella.· suborbicular; transversely sulcated on the side; base projecting with deep grooves, bowed obliquely—Touraine.

Donax.

retusa.· wedge-form, flat, blunt forwards; fine transverse striæ, margins entire—1 inch wide—Parnes.

incompleta.· ovato-triangular; smooth, round on the foreside; two hinge teeth, no lateral ones—small—Beynes.

tellinella.· ovato-oblong, finely striated transversely; remote lateral teeth; margins entire—small—Grignon.

nitida.· ovato-oblong, smooth, polished; two lateral teeth—small.

lunulata.· orbiculato-ovate, flat; blunt at the foreside, the striæ very fine—¾ inch—Houdau.

obliqua.· longitudinal, ovately oblique, smooth; margins entire; one tooth on one valve and two on the other; vestiges only of lateral ones.

Cyprina.

gigas.· large, cordato-rotund, with fine remote stria; large opening beneath the beaks; lateral teeth obsolete—5½ inches—Italy.

islandica.· cordate; striated transversely; retains epidermis; foreside rather angular; no posterior depression—Sienna. Italy.

Piedmontana.· round, thin; transversely grooved; posterior opening oblong; lateral tooth obsolete—2 inches—environs de Turin.

corrugata.· ovato-cordate; grooved transversely, with interstitial vertical striæ; impression posterior—4 inches—Italy.

tridacnoides.· transversely ovate; corrugated, striæ vertical; plicated on the upper surface.

tenuistria.· longitudinally ovate, thick brown, white within, transverse concentric striæ, border crenated; no posterior opening, with an isolated tooth as in *cytherea concentrica*.

islandicoides.· roundish; longer than wide; cordated, striæ transversely upwards; foreside not angulated; no posterior opening.

umbonaria.· rounded and cordate, subantiquated; delicately striated transversely; base tumid; no opening beneath the beaks.

Venus angulata, Sowerby.

Cytherea.

erycinoides.· rather depressed, white spotted with brown, transverse grooves, very obtuse—Bordeaux.

Analogue, *cedo nulli?*

multilamella.· inequilateral, distinct, transverse grooves—Montmarin.

scutellaria.· suborbicular, thin, rather flat; striæ distant—2½ inches.

demisulcata.· ovato-trigonal; on the upper part of the foreside transversely sulcated; sides flat; corselet sunk— Grignon.

Cytherea, *continued.*

nitidula .· ovate, inequilateral; small transverse striæ, sometimes obsolete—Grignon.

polita .· ovate, rather flat; beaks very small, recurved, pointed.

antiquata .· trigonal, subcordated, transversely striated; grooves beneath the beaks—1½ inch wide—Pontcharin.

lævigata .· oblongo-transverse, smooth, polished; beak obtuse, recurved—Grignon.

tellinaria .· obovato-trigonal, smooth; lunule ovato-oblong—Grignon.

elegans .· ovato-orbiculate; with transverse, parallel grooves; lunule ovate—¼ inch.

deltoidea .· ovato-trigonal; fine transverse striæ; hinder side rounded—small.

corbulina .· suborbicular, ventricose; transverse striæ very slight; valves very thick and concave—very small.

Venus.

casinoidea .· cordated, oblique, compressed, angulated forwards; transverse, sublamellous grooves, most numerous in the upper part of the valves—Italy.

Resembles *V. casina.*

paphia .· subcordate, subcompressed, oblique, with thick transverse rugæ—North Carolina.

eratina .· subcordated, trigonoidal; concentric, transverse striæ; inner margin crenulated—Touraine.

obliqua .· long and rounded, rather smooth; beak obliquely recurved.

callosa .· orbiculato-cordated, subangulate; beaks prominent, obliquely incurved; valves callous internally, externally striated—Grignon.

texta .· ovate; cancellated by the intersections of oblique lines; lunule oval.

Venericardia.

planicosta .· obliquely cordated, very thick; transversely ribbed, ribs flat; entire.

Chama rhomboidea, Brocch.

petuncularis .· orbicular, subequilateral; ribs convex, subimbricated, laterally muricated—Beauvais.

imbricata .· suborbicular; ribs convex, imbricatedly squamous, nodose, rough—Grignon.

acuticosta .· suborbicular; ribs carinated, squamoso-dentated, rather rough.

mitis .· suborbicular; numerous, separate, compressed ribs; back smooth, crenulated behind—Boves.

senilis .· obliquely cordated, very inequilateral, with large convex, obsoletely crenulated ribs—Angers.

concentrica .· suborbicular, rather depressed; concentric, elevated, lamellose striæ, with grooves—Chamont.

decussata .· suborbicular; longitudinal ribs cancellated by transverse striæ; hinge teeth divaricated—Grignon.

elegans .· suborbicular; numerous elevated, compressed ribs, backs squamosely serrated—Grignon.

Cardium.

distans: tumid, subequilateral; sixteen ribs, obtuse, smooth, and distant—England.

echinatum: tumid; ribs flat, grooved, with thick earformed papillæ.

burdigalinum: gaping forwards, ribs smooth in the middle, serrato-spinose before, and crenato-squamous in the hinder part; border of the opening deeply serrated—Bordeaux.

porulosum: margin serrated with ligulated teeth; ribs carinated, crenulated, and porulous at their base—Grignon.

sulcatinum: longitudinally sulcated; corselet and lunule smooth.

rhomboides: subtransverse; sixteen distant ribs, transversely sulcated.

diluvianum: angulated in the fore part; fourteen ribs, distant, convex; corselet raised, subcarinated—Sienna.

serrigerum: thirty ribs, with serræform teeth; sharpest on the foreside—Grignon.

Telluris: shaped somewhat like *cardium cardissa*; the carinated back of the valves sulcated; the anterior side flat; back part convex; with obtuse entire keels—Mons and St. Jean d'Asie.

lithocardium: subtrilateral; valves with carinated ribs on the back, diminishing upwards, very sharp.

cymbularia: long, subtrilateral; valves with carinated ribs, diminishing to points upwards; longitudinally sulcated—Valogne.

umbonare: obliquely cordated; seventeen ribs, transversely striated; base large—Sienna.

Hillanum: obliquely cordated; transverse, close, concentric striæ; longitudinally sulcated on the foreside—England.

hibernicum: rounded; valves sulcated and carinated; sides transversely produced, pervious at the extremity, hinder part shortest, truncated, projecting in the middle—England.

discors: subcordated, thin, rather smooth; with longitudinal striæ anteriorly, and transverse ones posteriorly.

porulosum: subcordated; edge serrated; ribs raised, crenulated, carinated, thin, porulous at the base.

asperulum: roundish, cordated, subechinated; numerous subsquamous convex ribs, about thirty-two; with erect fornicated squamæ.

calcitrapoides: roundish cordated; fore part echinated; convex ribs, twenty to twenty-two, mostly smooth, but sharp in the fore part.

Cardita.

gallicana: roundedly rhomboidal, oblique; ribs radiating, subsquamose; upward, the squamæ more distant—Angers.

rudista: obliquely cordated, transverse; ribs round, separated; squamosely echinated in the forepart—Sienna.

Etrusca: obliquely cordated; ribs nearly flat and smooth—Sienna.

crassa: oblong, rather winding backwards; ribs thick, rounded, imbricatedly squamose; squamæ obtuse.

Cypricardia.

coralliophaga: thin, oblong, rather cylindrical; decussatedly striated; compressed before; marginal striæ prominent in laminæ—Italy.

modiolaris: oval-oblong; tumid; transverse, bowed striæ; lunule ovate, impressed—Caen.

Cypricardia, *continued*.

obliqua: obliquely cordated, convex, rather smooth; upper border rounded; no transverse striæ—Mouliers.

trigona: cordato-trigonal, short; with very small transverse striæ.

Isocardia.

Cor: cordato-globose, smooth—Italy.

arietina: oblongo-cordate, with deep longitudinal grooves; bases large, terminating in two contorted turns—Italy.

Cucullæa.

crassatina: subcordated, ventricose, with interrupted longitudinal grooves, sometimes none; a very short internal auricle—Beauvais.

Arca.

scapha: transversely oblong, ventricose, many ribbed; the ribs flat; umbos oblique—Demifossil—Timor.

diluvii: ovato-transverse, ventricose, many ribbed; ribs thirty-two to thirty-six, flat, transversely striated; area sloping; margin crenated—2 inches wide—Plaisance.

biangula: transversely oblong; decussated, with granulato-squamous striæ, the foreside produced, with two angles—1¼ inch wide.

scapulina: oblongo-ovate; transverse, windingly contracted in the middle; with longitudinal grooves closely granulated—Grignon.

Arca barbatula, Annales du Mus.

interrupta: ovato-oblong; transverse, depressed, longitudinally grooved; hinge interrupted, with few teeth; beaks contiguous—Parnes.

clathrata: ovato-transverse, depressed, finely cancellated; foreside oblique, beaks approximated—¾ inch—Angers.

angusta: transversely oblong; narrow, rather depressed; decussated; beaks approximated—Grignon.

quadrilatera: transverse, oblongo-quadrate, windingly depressed in the middle, decussating striæ; the long striæ most conspicuous.

mytiloides: oblong, very smooth, obsoletely striated longitudinally; valves compressed in the middle—Plaisance.

Pectunculus.

pulvinatus: orbiculated, transverse, subequilateral; with longitudinal grooves and striæ; beaks small—Grignon.

Analogue of *P. glycemeris?*

cor: obliquely cordate; tumid; with longitudinal, rather distinct grooves; base subturgid—Bordeaux.

obovatus: convex, subequilateral; very thick, superior margin rounded; no longitudinal striæ—Weissenstein.

planicostalis: ovato-orbiculate; ribs numerous, small, flat, angular on one side; transverse striæ obsolete—Pontchartrain.

transversus: elliptical transversely, rather tumid; equilateral; remote longitudinal grooves, with very fine decussating striæ.

nudicardo: transversely elliptical, tumid; hinge, without teeth in the middle; but few at the extremities.

subconcentricus: suboval, rounded, convex, longitudinally striated; some distant, transverse, concentric grooves on the upper part.

An *P. decussatus,* Sowerby?

Pectunculus, *continued.*

nummiformis: lenticular, not eared, rather smooth; transversely concentric, and longitudinal striæ, blended or separate—Touraine.

pygmæus: orbicular, subequilateral, depressedly convex, small, with transverse and decussating longitudinal striæ—Grignon.

nuculatus: inequilateral, obliquely transverse; very fine transverse striæ; beaks conniving—Grignon.

Nucula.

rostralis: transverse, oblong, gradually rostrated forwards, base tumid; corselet concave, lanceolated—Bourgogne.

emarginata: ovate; striæ obliquely transverse; foreside produced.

deltoidea: triangular, inflated; foreside obliquely truncated; rounded backward; corselet flat—Grignon.

placentina: ovately transverse; rather large, oblique, longitudinally striated, pearly within, margin crenulated.

margaritacea: obliquely ovate, subtriangular, rather smooth, internally pearly; prominent hinge tooth—Grignon.

striata: ovate, subplicated forwards, with elegant transverse striæ; no hinge tooth—Grignon.

Trigonia.

scabra: ovato-trigonal, produced forwards, with transverse tuberculatedly scabrous ribs.

T. spinosa?—St. Paul-Trois chateaux.

crenulata: ovato-trigonal, produced forwards, many ribbed; ribs transverse, bowed, obliquely crenated, with numerous oblong crenulations—Mons.

aspera: ovato-trigonal, subcompressed, produced forwards; ribs transverse, remote, tuberculatedly rough; corselet raised, more smooth, but carinated.

dædalea: ovato-rhomboidal, subangulated, rather depressed, fore part with rather large hemispherical tubercles in transverse rows; hinder, with smaller tubercles in varying directions—Coulaines.

navis: ovato-trigonal; extended and compressed forwards; longitudinal tuberculato-nodose ribs; hinder area flat, transversely ribbed.

costata: ovato-angulated; trigonal; ribs smooth, transverse; corselet large, longitudinally grooved, carinated in the upper part—Havre.

sulcataria: trigonal, subcuneated, produced anteriorly, and becoming thinner; posterior transverse and anterior longitudinal grooves; corselet striated transversely.

sinuosa: ovato-angulated, trigonal; transverse smooth ribs, sinuously angular; corselet smooth.

rugosa: ovato-trigonal, depressed, subangulated, with transverse rugæform ribs; anterior ones smooth, posterior subtuberculated.

crassatellina: trigonal, depressed, with transverse angularly plaited grooves; margin crenulated.

cardissoides: cordated, depressed on the sides, valves raised in a flat keel on the back; beaks prominent, rather remote.

Assumed to be of this genus, but the hinge not known.

Trigonia, *continued.*

inflata: trigonal, turgid, produced forwards, wedge-shaped, rather smooth, truncated behind; the posterior area much cordated.

Bourguet, Petrif. 153.

arcuata: trigonal; longitudinal, bowed ribs; obsolete, decussating transverse grooves; beaks compressed.

Chama,

lævigata: left-turned, smooth, fixed obliquely; small valve flat, subconcave.

gryphina: left-turned, imbricated; with unequal, for the most part, depressed squamæ on the smaller valve; the border partly crenulated—Piedmont.

lacernata: the smaller valve flat, subantiquated; thick waving transverse frills, back longitudinally striated—Mont Marius.

turgidula: rounded, turgid; small valve convex, imbricated, with short overlying lamellæ; back striated.

echinulata: oval, tumid, echinated with numerous subtubulated squamulæ—Plaisance.

unicornaria: subimbricated, rough, with unequal, semierect, vaulted squamæ; base of the larger valve extended.

lamellosa: ovate, rounded, transversely plicated, with pointed, fimbriated, concentric, lamelliferous folds; lamellæ dentated—Grignon.

calcarata: orbiculate, with acute distant transverse folds; the upper ones echinated in rays with very long canaliculated spines.

Tridacna.

pustulosa: transversely fusiform, ribbed, waved, sprinkled with numerous pustules; lips of the lunule reflected—Normandy.

Modiola.

subcarinata: oblong, smooth; lower margin keeled; upper curved inward—Grignon.

tulipea: oblong, windingly contracted upwards; obsoletely keeled beneath; scutellum of the beaks circumscribed with ribs—Havre.

cordata: oblong, subcordated beneath; ribs at the beak, very tumid.

solenoides: elongate, narrow, roundedly angulate, rather bowed; forepart obliquely sulcated; no keel—Chauffour.

lithophagites: long, straight, roundish beneath, thin; upper part rather depressed.

Presumed fossil.

Mytili.

scapularis: subtrigonal, ovatedly wedge-form; forepart obliquely rounded, margin sharp; hindpart blunt, grooved longitudinally, subdecussated—Coulaines.

margaritaceus: oblong, thin, pearly, tumid, posteriorly forming a longitudinal smooth rib; longitudinal and transverse striæ—England.

Pinna.

subquadrivalvis: narrow, wedge-form; subtetragonal; dorsal angle of the valves slit—Parma.

Perna.

maxillata: trigonal, convexo-depressed, thick; hinge very broad, furrowed with numerous long sulciform teeth—Virginia.

mytiloides: ovato oblong, depressed, base pointed; hinge oblique.

Avicula.

trigonata: very small; wing very oblique; foreside subtruncated, with a bowed sinus—Grignon.

phalænacea: small, wing very oblique, hinder ear longitudinally grooved—Bordeax.

Lima.

spathulata: oblongo-ovate, depressed upwards, rays squamalous, hinge straight—Grignon.

mutica: ovate, oblique, inequilateral, both sides gaping, rays smooth, rather sharp.

plicata: ovate, inequilateral, subtruncated forwards; rays plicæform, obtuse, rather smooth, obsoletely squamous—Touraine.

vitrea: oblong, thin, pellucid, depressed, hinge oblique—Grignon.

dilatata: roundedly ovate, oblique, depressed, rays thin, obsolete, distant.

Plagiostoma.

transversa: large, transversely ovate, upper part rounded; lower sides oblique; numerous longitudinal grooves, transversely striated—6 inches wide.

semilunaris: large, trigonal, smooth, very wide on the foreside, semicircular, with a sharp edge, hinder side truncated, thick, subconcave, one-eared—Calvades.

turgida: longitudinally grooved, upper valve with sharp serrulated grooves; the other with smooth and obtuse ones—Chateau de Loir.

depressa: suborbicular, lower part rather thin, upper rounded, small longitudinal striæ divaricating to the side.

sulcata: ovate, lower part subacute, longitudinally radiiform, subcarinated grooves.

inequivalvis: upper valve flat, longitudinally striated; near the border rough with vaulted squamulæ—Bordeaux.

Pecten.

solarium: suborbicular; rather convex on both sides; rays fifteen or eighteen, distinct, flat, scarcely any longitudinal striæ—Doué.

multiradiatus: convex on both sides; eighteen to twenty rays, distinct, convex, and smooth.

rugosus: convex on both sides; fourteen to eighteen convex rays; transversely rugose—Normandy.

laticostatus: suborbicular, large, convex on both sides, seven to ten flat, very broad, faint, rays; grooves longitudinal, obsolete.

The largest *pecten* known—8 inches wide.

rotundatus: suborbicular, convex on both sides; fourteen to sixteen distinct convex rays, flat towards the circumference—Vence.

burdigalense: suborbicular, very wide, convex, radiated on both sides, from twelve to fourteen convex rays, becoming flat towards the circumference—5½ inches.

Pecten, *continued.*

aculicosta: suborbicular, rather convex on both sides, with twenty-one rays on the back, acute and smooth—2¾ inches.

asper: suborbicular, convex on both sides; twenty to twenty-two rays, longitudinal, imbricated, squamous, rough, divided by grooves—3¼ inches.

benedictus: inequivalved, upper valve plano-concave, lower very convex; twelve to fourteen flat rays, distinct, transversely striated.

elongatus: ovato-oblong; twenty-six to thirty rays, thin, unequal, subdenticulated—3 inches—Mons.

subacutus: longitudinal, ovately wedge-form; twenty-four close, equal rays, sharp on the back—1½ inch.

phaseolus: very small, oblongo-trigonal; lower valve bowed inwards; rays small, close, striæform, equal—½ inch—Coulaines.

æquicostatus: unequal valved, trigonal, upper valve flat; under valve tumid, bowed inwards; twenty-eight to thirty rays, close, equal, smooth—Mons.

versicostatus: unequal valved, trigonal; upper valve flat; under valve tumid, bowed, curved inwards; numerous close rays, some remote, others more raised—Mons.

costangularis: unequal valved; lower valve bowed, curved inwards; four large anguliform, longitudinal, grooved rays—Decize.

orbicularis: suborbicular, depressed, rather convex, no rays, striæ transverse, concentric—Coulaines.

discors: subinequivalved, roundedly trigonal, rays ten, fine transverse rugæ on the other valve—Chauffour.

palmatus: ovato-rotundate, five or six faint rays; one ear very large.

lepidolaris: ovato-rotundate; with twenty squamoso-imbricated rays: squamæ small, disposed in many rows—1 inch—Boutonnet.

sieniensis: suborbicular, convex on both sides; striæ longitudinal—1½ inch.

striatulus: suborbicular, convex on both sides; ten or twelve thick rays; interstices longitudinally striated—1¼ inch.

inæquicostalis: suborbicular, twelve to fourteen unequal rays, with the interstices longitudinally striated—1¼ inch.

scutularis: ovato-rotundate, subdepressed, small; twenty to twenty-five equal rays, rather sharp on the back—¾ inch—Bourgogne.

scabrellus: suborbicular, with fifteen sulcated rays, squamously denticulated; ears unequal—1¼ inch—Italy.

plebeius: suborbicular, with twenty-five to thirty angulato-sulcated rays; sides squamosely scabrous—Grignon.

pumilus: very small, roundedly ovate; ten or twelve rays.

squamula: very small, orbicular.

Plicatula.

angulosa: oblong, wedge-formed; with large unequal folds, backs angular, squamose—2 inches.

radiola: rounded; plano-concave upwards; with numerous subsquamous radiating ribs; margin plaited—¾ inch.

placunea: obliquely oval, plano-concave upwards; with squamous tuberculated radiating ribs and striæ; margin plain—Env. de Paris?

ostreiforme: rounded, irregular; with oblique folds, subsquamose.

Plicatula, *continued*.

tubifera: subirregular, varied, windingly flattish; echinated with short tubular squamæ.

rugosa: oval, very hollow; upper valve flat, longitudinally sulcated; obsolete, transverse, concentric rugæ, margin entire—2½ inches.

Spondylus.

crassicosta: rounded, very wide; ribbed and grooved longitudinally.

rastellum: sublongitudinal, thick, very hollow, ribs and grooves longitudinal, rough, with unequal squamæ—3 inches long and 2½ wide—Turin.

radula: obliquely rounded; with slight longitudinal grooves, rough from squamæ; with others, interstitial, smaller and smoother—1½ inch—Grignon.

podopsideus: trigono-cuneate, rather smooth on the upper part, longitudinally sulcated, distant tuberculiferous ribs on the larger valve; tubercles fornicated—2¼ inches—Havre.

Podopsis.

truncata: longitudinal, wedge-formed, rounded upwards, suboblique; with fine longitudinal striæ, sometimes rough with a few spines; the extended beak crenated—Touraine.

gryphoides: ovato-rotundate, extremely ventricose beneath, smooth, adherent by the larger beak.

Gryphæa.

columba: ovately rotundate, dilated smooth, with a small oblique hook—Mons.

cymbium: ovately rotundate, rather smooth, upper valve concave, hook slightly oblique.

arcuata: oblong, incurved, transversely rugose; with a large suboblique hook.

G. incurva, Sowerby.

secunda: oblong, with oblique beak.

lituola: larger valve flat on one side; with tuberculated rib, subcarinated on one side.

plicata: bowed, carinated beneath; folds oblique; with a lateral hook—Gazonfier.

distans: variable, oblong, oblique; hook twisted, lateral; the folds of growth bowed, concentric and distant—Mons.

angusta: oblong, narrow, curved, obsoletely carinated beneath; hook lateral—Rochelle.

plicatula: oval, oblique, underneath slight oblong folds, hook lateral—Mons.

silicea: oval, oblique; no folds; hook lateral—Rochefort.

Ostrea.

Valves plaited, margin dentated.

serra: suborbicular, sinister, gigantic, thick; teeth of the margin large, erect, acutangulate—6¼ inches wide.

diluviana: suborbicular, right, teeth acutangulate—3 inches—Mons.

flabellum: flabellatedly ovate; long subdivided, convex folds, obsoletely squamous; bowed on each side—2¼ inches.

Ostrea, *continued.*

flabelloides: subtrigonal, thickly plaited; plaits large, with sharp backs, subimbricated; oblique at the sides.

placunata: semicircular, flat and plaited on both sides; with squamous plaits, divaricating to the sides.

flabellula: oblong, wedge-form, rounded upwards, rather bowed; with longitudinal rugose folds, one beak produced—Grignon.

pectinata: oblong, bowed, pectinated in folds, valves convex, margin serrated, with a middle groove—3 or 4 inches.

phyllidiana: oblong, thick, back convex, with subimbricated plaits on both sides—4 inches—Angers.

leporina: oblong, bowed, thick; disks convex, carinated; two rows of plaits; outer margin prominently rounded—4½ inches.

carinata: oblong, upper and under valve rather acute; sides flat, bowed; valves complicated, backs carinated, with transverse plaits.

colubrina: oblong, narrow, bowed, plaited; valves semicomplicated, outer side convex.

scolopendra: oblong, narrow, reduced toward the apex, plaits in two rows; oblique, becoming gradually shorter—1½ inch—Mons.

larva: oblong, curved, plicated on the sides; rows of plicæ unequal; margins crenated—Maestricht.

pennaria: oblong, subarcuate, plicated in two rows; plicæ of the sides oblique, curved—Champagne.

bifrons: ovato-rotund; upper valve convex, smooth; lower longitudinally plicated; margin crenated—Grignon.

undata: ovato-oblong, thick, obsoletely plicated, plicæ undate, imbricato-squamous: one beak produced—Bordeaux.

Valves not plicated.

crassissima: elongate, very thick, ponderous; beak long, wide, channelled, striated transversely; apex rather hooked.

longirostris: lower valve thick, subcucullated; beak very long, contorted—Sceaux.

canalis: ovato-oblong, very thick; lower valve, with prominent beak, channelled, with a flat margin on each side—5 inches.

callifera: ovato-rotund, a thick callus near the base; rather eared, excavated internally—Rocquencourt.

O. hippopus, Annales du Mus.

brevialis: rotundato-trigonal, base rather pointed, very thick; ligamental canal produced, apex bowed on one side—3 inches.

scalarina: oblong, reduced toward the base, with transverse, bowed, rather distant, step-like rugæ—2 inches.

edulina: reduced at the base, with imbricating, undulating lamellæ; upper valve flat.

bellovacina: oblongo-cuneated, rounded upwards; larger valve grooved at the base radiatedly.

multilamellata: oblong, apex dilated, rather bowed, thick; with numerous, imbricated, depressed lamellæ—3½ inches.

linguatula: ovato-spathulated, oblique, rather flat; lower valve rostrated.

crenulata: oval, depressed, slightly lamellated, crenulated; chiefly on the inner margin—size of *O. edulis.*

Ostrea, *continued.*

cucullaris: cuneato-spathulate, base rostrated.
O. cochlearia, Annales du Mus.
vesicularis: semiglobose, base retuse, smooth; lower valve ventricose; upper plano-concave—Meudon.
biauriculata: semiglobose, base truncated, biauriculated; lower valve very ventricose; upper valve flat, operculiform—2½ inches.
obliqua: obliquely ovate, smooth; lower valve ventricose; upper valve flat; hinge very short.
lingularis: elongate, sublinear, flat, narrow towards the base, lamellæ compact—2 inches—Mons.
squama: ovato-trigonal, flat, but rounded upwards; concentric transverse rugæ; with internally decumbent cylindraceous tubercles—size of a finger nail.
anomialis: suborbicular, thin, smooth, convex beneath, upwards flatter.
pseudo-chama: irregularly orbiculate, ligamental pit narrow, very oblique—2 inches.
cyathula: suborbiculate, with imbricated lamellæ, lower valve concave, margin crenulated—1½ inch.
deformis: deformed, subdepressed on one side, very irregular.
uncinata: semiorbiculate, hooked, depressed; a lamellous sinus on one side.

Vulsella.

deperdita: oblong, sublingulate, convexo-depressed; striæ transverse, concentric; base retuse—Grignon.

Placuna.

pectinoides: obliquely trigonal, flat upwards; radiated with costellæ, a little convex beneath.

Sphærulites.

foliacea: The only species known.

Radiolites.

rotularis: valves forming opposite, short, nearly equal cones.
ventricosa: lower valve turbinated, upper valve ventricose; opercule retuse.

Calceola.

sandalina: formed like the point of a slipper: the only species known.

Birostrites.

inæquiloloba: two long, conical, rostriform, unequal valves, disposed in an obtuse or rather open angle, and united at their base, but the edge of one overlapping that of the other.

Discina.

ostreioides: small, flat, ovato-rotundate: adhering to the stones on the sea-coast.

Crania.

personata: orbiculate; the upper valve conical; the lower valve with three little pits.

nummulus: suborbicular, free, flat, radiatedly striated within; three little pits; margin thick, not crenulated.

Only one valve known, perhaps the under, but with no marks of adherence on the back—Sweden.

Nummulus Brattenburgii.

Parisiensis: resembles the former; but shows marks of adherence.

antiqua: lower valve adhering only by its beaked termination under the hinge, striated beneath concentrically; three pits; the upper valve very convex, with three impressions answering to the pits of the under valve—Nehou.

striata: very small, rounded; lower valve flat, subtruncated, adherent; prominent calluses within; the free valve orbicular, back raised, radiatedly striated.

Orbicula.

Norwegica:

Patella anomala, Mull.

Terebratula.

Smooth, not grooved.

subundata: subglobose, smooth; with fine concentric striæ, margin subundulated; valves nearly equally ventricose—Warminster.

carnea: subrotund, subdepressed, smooth; with five concentric striæ; beak elevated, incurved; foramen very small—near Norwich.

depressa: oblong; transversely dilated, contracted and obtuse upwards; with smooth concentric striæ; beak produced, not incurved; foramen large—St. Saturin.

ovalis: transversely and superiorly dilated; with concentric, smooth striæ; beak incurved.

numismalis: depressed, subrotund, smooth; a sinus in the upper part of each valve; distant concentric striæ; beak short; foramen very small.

This shell, though round, shows five angles.

umbonella: elongated, turgid, transversely compressed; above obtuse; smooth, with a raised umbo; beak incurved—Montigny.

digona: elongated, subgibbous, grooved upwards, smooth, terminating in two angles; beak raised and incurved—near Bath.

This species generally shows very plainly a beautifully punctated surface: a similar surface is observable in several of the smooth species.

deltoidea: compressed, transversely dilated, triangular, smooth; margin straight in the upper part, winding in the middle.

triangulus: elongated, triangular, smooth; the lower valve reflected on the upper, with a groove on the margin.

cor: cordiform, subglobose, a deep sinus in the upper part; decussated with delicate striæ.

birostris: subglobose, smooth; contracted upwards, sinuated in the middle; sinus with two angles, margin not plicated.

Terebratula, ***continued.***

ampulla: subrotund, inflated, antiquated; upper margin obscurely biplicated—Italy.

carinata: subquadrangular, smooth; lower valve rather flattish; upper valve diëdral, the two surfaces divided by a longitudinal keel, formed by their union at an obtuse angle.

concava: small, lower valve flat; upper one larger and concave, with concentric striæ—Meudon.

semiglobosa: elongate, ovate, tumid, very smooth; umbo raised, margin entirely without plicæ—Warminster.

punctata: oblong, subdepressed, upward biplicated, with concentric striæ; and with minute points disposed in undulating lines.

phaseolina: small, subcompressed, subrotund, with concentric striæ; upper margin subbiplicated; beaks short—Mons.

ovata: ovato-oblong, subcompressed, smooth; with distant concentric striæ; beak produced—Heytesbury.

biplicata: subrotund, subglobose, smooth, biplicated upwards; concentric striæ; beak incurved; plane of the foramen horizontal—Cambridge.

bisinuata: subrotund, subdepressed, antiquated, smooth, upwards biplicated; beak produced, not incurved; plane of the foramen inclined upon that of the valves—Grignon.

Kleinii; ovate, depressed, subantiquated, smooth, biplicated upwards; finely and closely punctated; beak incurved.

Piedmontana: subrotund, subdepressed, transversely striated, biangulated upwards; umbo elevated, beak recurved.

quadrifida: triangular, depressed, dilated; four angles upwards, beak short.

angulata: subtrigonal, ventricose, upper margin deeply grooved, with three acute angles, longitudinally striated.

multicarinata: large, round, pectiniform, with numerous carinated ribs; margin not grooved—3 inches long by 3¼.

tetraëdra: gibbous; upper valve deeply grooved; in the groove and sides three or four angulated ribs; beak incurved—Aynhoe.

plicata: subtetraëdral, plicated, not grooved; five or six ribs obtuse at the base, angulated at the margins; beak short.

canalifera: trigonate, gibbous, longitudinally sulcated with a deep groove; hinge straight, beak large, striated perpendicularly to the hinge.

lævicosta: trigonate, gibbous, grooved in the sides: a sinus in the middle of the larger valve, and a broad rib in the less, both smooth; striæ transverse; hinge straight; beak short—Bemberg.

intermedia: subtetraëdral, dilated, plicated, grooved; four plaits to the groove and five to the sides; beak short.

alata: subtrigonate, dilated; a deep sinus upwards, beak short.

concinna: globose, subsinuate, plicated; five to seven raised plaits in the middle, ten to twelve on the sides; beak produced.

media: subtrigonate, gibbous, sinuate, plicated, six plicæ in the middle, seven or eight on the sides; beak subrecurved—Aynhoe.

pectita: subrotund, larger valve subconvex, smaller rather flat, with radiating plaits; beaks produced, recurved—Horningsham.

Terebratula, ***continued.***

cardium: elongato-ovate, convex, plicated, with thick longitudinal rounded grooves, beak rather prominent.

difformis: trigonate, dilated, subdepressed; margin unequal, windingly bent in the middle; beak rather produced—Havre.

lyra: subglobose, contracted forwards; beak *so* produced as to equal in length the smaller valve—Horningsham.

Menardii: globose, truncated in the base, larger valve having a deep longitudinal groove; margin sinuously deflected—Coulaines.

decussata: subpentagonal, subconvex; larger valve canaliculated; striæ fine, decussating; beak rather produced, foramen large.

spinosa: globose, dilated, with small spinous grooves; beak very short, pointed.

spathica: subtrigonate, subglobose, smooth; upper margin grooved, beak pointed, subproduced—From the hills to a great extent near Mons.

compressa: dilated; upper margin dentated, subflexuous; beak produced, pointed—Mons.

granulosa: subdepressed, rounded; upper margin rostriform, produced forwards; grooves granular; beak short—Mount Marius.

articulus: trigonal, depressed, delicately striated longitudinally; upper margin angular, beak short.

radiata: subdepressed, rounded; contracted in the lower part, dilated in the upper; radiating longitudinal grooves; margin subflexuous.

pumila: very small, compressed, small valve flattish, radiated with longitudinal grooves, beak pointed, produced—Maestricht.

spirifera: trigonate, transversely dilated, with spiral bodies placed in the inside over the lower border, which is angular; beak short, perforated—Derbyshire *.

Almost all the above English *Terebratulæ* are contained in Mr. Sowerby's elegant work on Mineral Conchology.

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* The shells possessing the characters here particularised form the genus *Spirifer* of Mr. Sowerby.

In accordance with the important fact ascertained by Mr. William Smith, of peculiar fossils being found in and characterising particular strata, the fossil shells in the succeeding table are arranged in the order of the strata in which they occur, commencing with the earliest. Each genus is placed under the formation in which it is first found; and each succeeding stratum is marked, in which the several species are discovered. But as, previously to Mr. Smith's "*Strata identified by Organized Fossils*," and Mr. Sowerby's *Mineral Conchology*, with *an arrangement of strata*, *shells, and places*, by Mr. Farey, contained in the last mentioned work, no publication has regularly particularised the strata in which the described fossils have been found, I have availed myself of the information yielded by Mr. Sowerby's work for the facts which the table contains. It is however proper to observe, that, in the present state of our knowledge, this table must necessarily be far from perfect. Many shells must exist in the different strata, of species, and even of genera, which have not yet been noticed; and various circumstances may have led to erroneous conclusions: but, notwithstanding this, it is hoped, that sufficient will be rendered evident by it to establish the important and valuable facts stated by Mr. Smith, and to assist the student in this part of his enquiries.

It is presumed also, that, by pursuing this mode of arrangement, we may assist and correct our conjectures, whilst contemplating the relative periods of the creation, duration, and extinction of the animals, which are only known to us through their mineralized or otherwise preserved fossil remains. To obtain complete information on these points may be impossible, but every approximation must be accompanied by interesting instruction.

A Table of British Fossil Shells,

Each Genus and each Species being placed in the Order of the Strata in which they occur.

The number (or letter) at the end of each species, points out the plate in Mr. Sowerby's Mineral Conchology in which that species is depicted.

Genera.	Species.		Strata.
PRODUCTUS.			MOUNTAIN LIMESTONE.
	longispinus	68	ditto
	Flemingii	68	ditto
	spinulosus	68	ditto
	scoticus	69	ditto
	spinosus	69	ditto
	aculeatus	68	Limestone rock (coal measures).
	scabriculus	69	ditto
	aculeatus	68	ditto
CONULARIA.			MOUNTAIN LIMESTONE.
	quadrisulcata	260	ditto
	teres		ditto
AMPLEXUS.			MOUNTAIN LIMESTONE.
	coralloides	72	ditto.
PENTAMERUS.			MOUNTAIN LIMESTONE.
	Knightii	28	ditto
	lævis		ditto
	Aylesfordii	29	ditto
ORTHOCERA.			MOUNTAIN LIMESTONE.
	annulata	133	ditto
	circularis	60	ditto
	striata	58	ditto
	gigantea	246	ditto
	cordiformis	247	ditto
	undulata	59	Grey limestone (coal measures).
	Breynii	60	Limestone shale.
	Steinhaurii	60	Coal shale.
	conica	60	Alum shale.
NAUTILUS.			MOUNTAIN LIMESTONE.
	discus	13	ditto
	pentagonus	249	ditto
	bilobatus	249	ditto
	tuberculatus		ditto
	complanatus	261	Slaty limestone.
	truncatus	123	Blue lias.
	striatus	182	ditto
	intermedius	125	Blue lias and crag.
	lineatus	41	Lower oolite.
	sinuatus	194	ditto
	obesus	124	ditto
	simplex	122	Green sand.
	undulatus	40	ditto

Genera.	Species.		Strata.
NAUTILUS.			
	inæqualis	40	Chalk marl.
	elegans	116	ditto
	Comptoni	121	ditto
	imperialis	1	London clay.
	centralis	1	ditto
	ziczac	1	ditto
AMMONITES.			MOUNTAIN LIMESTONE.
	striatus	53	ditto
	sphæricus		ditto
	Walcotii	106	Alum shale. Lower oolite. Upper oolite.
	Henslowi	262	Grey limestone, Isle of Man.
	Listeri	280	Coal shale.
	annulatus	222	Alum shale. Lower oolite.
	ellipticus	92	White lias clay.
	planicosta	73	Upper lias clay. Marston or lias marble. Chalk marl.
	communis	107	White lias clay.
	armatus	95	Lias clay.
	angulatus	107	ditto
	Bucklandii	130	Blue lias.
	Coneybeari	131	ditto
	Greenoughi	132	ditto
	fimbriatus	164	ditto
	obtusus	167	ditto
	Henleyi	172	ditto
	Loscombi	183	ditto
	Birchi	267	ditto
	Brooki	190	ditto
	Bechei	280	ditto
	Brongniarti	A	Lower oolite.
	Banksii	200	ditto
	Blagdeni	201	ditto
	Brocchii	202	ditto
	Sowerbii	213	ditto
	Browni	263	ditto
	Gervillii	A	ditto
	Strangewaysi	254	ditto
	falcifer		ditto
	nodosus	92	Clay under the lower oolite.
	discus	12	Cornbrash.
	Calloviensis	104	Kelloway rock.
	Koenigi	263	ditto
	Duncani	157	Clunch clay under coral rag, or Oxford clay.
	excavatus	105	Calcareous grit beneath coral rag.
	vertebralis	165	ditto
	plicatilis	166	ditto
	splendens	103	Coral rag. Chalk marl.

Genera.	Species.		Strata.
AMMONITES.			
	jugosus	92	Clay under the lower oolite.
	elegans	94	ditto
	concavus		ditto
	cordatus	17	Kentish rag.
	rotundus	293	Kimmeridge clay.
	Lamberti	242	ditto
	Leachi		ditto
	omphaloides		ditto
	triplicatus	92	Portland freestone.
	stellaris	93	ditto
	giganteus	126	ditto
	Goodhalli	256	Green sand, Devon.
	Nutfieldiensis	108	Green sand.
	monile	117	ditto
	inflatus	178	ditto
	auritus	134	ditto
	rostratus	173	Chalk marl.
	minutus	53	ditto
	varians	106	ditto
	Mantelli	55	ditto
	rusticus	177	Lower chalk.
	biplex	293	Blue clay, Suffolk.
	decipiens	294	ditto
	acutus	17	Blue clay, Sheppey.
	binus	92	Crag.
	quadratus	17	ditto
	serratus	24	ditto
NAUTELLIPSITES.			MOUNTAIN LIMESTONE.
	ovatus	37	ditto
AMMONELLIPSITES.			MOUNTAIN LIMESTONE.
	funatus	32	ditto
	compressus	38	ditto*
EUOMPHALUS.			MOUNTAIN LIMESTONE.
	pentangulus	45	ditto
	catillus		ditto
	nodosus	46	ditto
	discors	52	ditto
	rugosus		ditto
	angulosus		ditto
CIRRUS.			MOUNTAIN LIMESTONE.
	acutus	141	ditto
	nodosus		Lower oolite.

Note.—*Nodosus, jugosus, elegans, concavus,* should precede Lower Oolite, page 232.

* Remains of other species, bearing, with the oval form, the characters of *Nautilus* or *Ammonites*, are found in some of the succeeding strata, but most frequently in the chalk marl and lower chalk.

Genera.	Species.	Strata.
CIRRUS.		
	Leachi 219	Chalk marl.
	plicatus	ditto
PLANORBIS.		MOUNTAIN LIMESTONE.
	æqualis 140	ditto
	euomphalus	Lower oolite. Green sand. Above the London clay.
	radiatus	Green sand.
	hemistoma	London clay.
	lens	Above the London clay.
	cylindricus	ditto
	obtusus	ditto
SPIRIFER.		MOUNTAIN LIMESTONE.
	cuspidatus 190	ditto
	trigonalis 268	ditto
	oblatus	ditto
	glaber 269	ditto
	obtusus	ditto
	striatus 270	ditto
	pinguis 271	ditto
TEREBRATULA		MOUNTAIN LIMESTONE.
	Mantiæ 277	ditto
	Wilsoni 118	ditto
	lateralis 83	Mountain limestone. Clay of upper oolite.
	biplicata 90	Mountain limestone. Green sand. Chalk marl.
	crumena 83	Coal shale. Blue lias marble (Marston).
	punctata 15	Marly sandstone of lower oolite.
	subrotunda	Ditto. Cornbrash. Chalk marl.
	ornithocephala 101	Upper lias clay. Cornbrash.
	acuta 150	Lower oolite
	resupinata	ditto
	lampas 100	ditto
	digona 96	Lower oolite. Oxford clay. Cornbrash.
	obovata 161	Cornbrash.
	intermedia 89	Cornbrash. Green sand.
	obsoleta 83	Cornbrash. Crag.
	concinna	Clay in oolite.
	media	ditto
	tetraëdra	ditto
	carnea	Great oolite. Upper chalk.
	inconstans 277	Kimmeridge clay.
	dimidiata 18	Green sand, Devon.
	ovata	Green sand
	pectinata 138	ditto?

Genera.	Species.		Strata.
TEREBRATULA			
	lyra		Green sand.
	semiglobosa	18	Chalk marl.
	subundata		Upper chalk.
	plicatilis	118	ditto
	octoplicata		ditto
	obliqua	277	ditto
	ovoides	100	Green sandstone in Alluvium.
	lata		ditto
GRYPHÆA.			MOUNTAIN LIMESTONE.
	incurva	112	Blue lias. Kelloway stone. Crag.
	dilatata	149	Under oolite. Clunch clay. Portland freestone. London clay, Alluvia.
CARDIUM.			MOUNTAIN LIMESTONE.
	hybernicum	82	ditto
	elongatum		ditto
	hillanum	14	Green sand, Devon.
	proboscideum	156	ditto
	umbonatum		ditto
	semigranulatum	144	London clay.
	nitens	14	ditto
	Parkinsoni	49	Crag
HELIX.			4th LIMESTONE, above the MOUNTAIN LIMESTONE.
	carinatus	10	ditto
	Gentii	145	Green sand.
	globosus		Above the London clay.
LINGULA.			COAL SHALE.
	mytilloides	19	ditto
	tenuis		London clay.
	ovalis		Crag.
UNIO.			COAL SHALE.
	acutus	33	ditto
	uniformis		ditto
	subconstrictus		Coal shale, alluvial clay.
	hybridus	144	Magnesian limestone.
	Listeri	154	Magnesian limestone. Crag.
	crassissimus	153	Lias. Portland freestone.
	crassiusculus	185	London clay.
PLAGIOSTOMA.			LIAS.
	gigantea	77	White lias. Blue lias.
	pectinoides	114	Blue lias.
	punctata	113	ditto
	ovalis	114	Fullers' earth.
	cardiiformis	113	Upper oolite.
	obscura	114	Kelloway rock.

Genera.	Species.		Strata.
PLAGIOSTOMA.			
	rigida	114	Portland freestone.
	spinosa	78	Lower chalk. Upper chalk.
TROCHUS.			LIAS.
	anglicus	142	Blue lias.
	abbreviatus	193	Under oolite.
	concavus	181	ditto
	dimidiatus		ditto
	duplicatus		ditto
	elongatas	193	ditto
	punctatus		ditto
	agglutinaus	98	London clay.
	Benettiæ		ditto
	lævigatus	181	Crag.
	similis		ditto
MODIOLA.			LIAS.
	lævis	8	ditto
	depressa		Alum shale. London clay.
	elegans	9	ditto
	parallela	9	Upper oolite.
	pallida	8	Green sand.
MELANIA.			LIAS.
	striata	47	ditto
	Heddingtonensis		Upper oolite.
	sulcata	39	London clay.
HELICINA.			LIAS.
	compressa	10	ditto
CARDITA.			LIAS.
	lirata	197	Lias. Cornbrash.
	obtusa		Under oolite.
	similis	232	ditto
	lunulata		ditto
	producta		Ditto. Cornbrash.
	abrupta	89	Great oolite.
	striata		ditto
	deltoidea	197	Cornbrash, Kelloway stone.
	tuberculata	143	Green sand.
MYA.			LIAS.
	scripta	224	Lias. Kelloway rock.
	angulifera		Fullers' earth bed, near Bath.
	literata		Grey limestone, near Scarborough.
	mandibula	43	Green sand.
	plana	76	Sand under London clay.
	intermedia		London clay.
	subangulata		ditto
	lata	81	Crag.
PECTEN.			UNDER OOLITE.
	fibrosus	136	Under oolite. Cornbrash. Kelloway rock.

Genera.	Species.		Strata.
PECTEN.			
	barbatus	231	Under oolite. Cornbrash. Kelloway rock.
	equivalvis		ditto
	obscura	205	Stonesfield slate.
	lens		Cornbrash.
	similis		Forest marble.
	rigida		ditto
	arcuata	205	Coral rag.
	lamellosa	239	Chicksgrove limestone. Green sand.
	orbicularis	186	Green sand.
	quadricostata	56	ditto
	quinque costata		ditto
	Beaveri	158	Chalk marl.
	cornea	204	London clay.
ASTARTE.			UNDER OOLITE.
	lurida	137	ditto
	elegans		ditto
	excavata	233	ditto
	lineata	179	Oaktree clay over Sussex marble, or Kimmeridge clay.
	cuneata	137	Portland stone.
	planata	257	Indurated marl at Gunton.
	plana	179	Crag.
	obliquata		ditto
TRIGONIA.			UNDER OOLITE.
	costata	85	ditto
	striata	237	ditto
	clavellata	87	ditto
	gibbosa	236	Tisbury limestone.
	duplicata	238	ditto
	dædalea	88	Green sand, Devon.
	spinosa	86	ditto
	eccentrica	208	ditto
	affinis	237	ditto
CUCULLÆA.			UNDER OOLITE.
	oblonga	206	ditto
	decussata		ditto
	carinata	207	Green sand, Devon.
	fibrosa		ditto
	glabra	67	Green sand.
NERITA.			UNDER OOLITE.
	lævigata	217	ditto
	sinuosa		Chilmarsh, near Tisbury.
LUTRARIA.			MIDDLE or GREAT OOLITE.
	gibbosa	42	Middle oolite.
	ambigua	227	Cornbrash.
	ovalis	226	Cornbrash. Upper oolite.
	lirata	225	Limestone at Norton Edge.

Genera.	Species.		Strata.
MYTILUS.			MIDDLE OOLITE.
	amplus	7	ditto.
	pectinatus	282	Kimmeridge clay.
	antiquorum	275	Crag.
	alæformis	275	ditto
OSTREA.			GREAT OOLITE.
	acuminata	137	Fullers' earth of great oolite. Clay over oolite, and on Wooburn sand
	Marshii	48	Cornbrash.
	palmetta	111	Oxford clay.
	deltoidea	148	Oxford clay. Kimmeridge clay. Clay over Sussex marble.
	gregaria	111	Coral rag. Green sand.
	expansa	238	Tisbury limestone.
	undulata		Farley, near Salisbury.
	Meadii	252	Somersetshire.
	canaliculata	135	Upper chalk.
	tener	252	Charlton.
	gigantea	64	London clay.
	pulchra	279	London clay and gravel.
	flabellula	253	ditto

☞ Fossil oysters occur also in the Lias formation.

Genera.	Species.		Strata.
VENUS.			CORNBRASH.
	varicosa	245	ditto
	lineolata	20	Green sand.
	planus		ditto
	angulata	65	ditto
	equalis	21	Green sand. Crag.
	incrassata	155	London clay.
	margaritacea	297	ditto
	gibbosa		Crag.
	rustica	196	ditto
	lentiformis	203	ditto
	turgida	256	ditto
ISOCARDIA.			CORNBRASH.
	minima	295	ditto
	tener	295	Kelloway stone.
	rostrata	295	Upper oolite.
	sulcata	295	Lond. clay (only a single individual)
PINNA.			CORNBRASH.
	lanceolata	281	Neighbourhood of Scarborough*.
	margaritacea		London clay.

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* I have taken the liberty to place this fossil under the Cornbrash, from the appearance of the matrix of that which I possess. I think that the Rev. Mr. Marsh, of Felmersham, has favoured me with fragments of this fossil from his neighbourhood.

Genera.	Species.		Strata.
VERMICULARIA.			UPPER OOLITE.
	ovata	57	ditto
	concava		Green sand.
	umbonata		Chalk marl.
	crassa		London clay.
SOLARIUM.			UPPER OOLITE.
	conoideum	11	ditto
	discoideum	11	London clay.
	patulum	10	ditto
HAMITES.			GREEN SAND, DEVON.
	spinulosus	216	ditto
	tenuis	61	Chalk marl.
	rotundus		ditto
	attenuatus		ditto
	compressus		ditto
	adpressus		ditto
	maximus	62	ditto
	intermedius		ditto
	gibbosus		ditto
	armatus		ditto
	spiniger	216	ditto
	nodosus		ditto
	tuberculatus		ditto
	turgidus		ditto
	plicatilis	234	ditto
CHAMA.			GREEN SAND, DEVON.
	canaliculata	25	ditto
	haliotidea		ditto
	recurvata	26	ditto
	conica		ditto
	plicata		ditto
	digitata	174	ditto
CORBULA.			GREEN SAND, DEVON.
	lævigata	209	ditto
	globosa		ditto
	pisum		London clay.
	gigantea		ditto
	revoluta		ditto
ARCA.			GREEN SAND
	carinata	44	ditto
	subacuta		Chalk marl.
	Branderi	276	Crag.
	appendiculata		ditto
PERNA.			GREEN SAND.
	aviculoides	66	Blue marl under green sand.

Genera.	Species.	Strata.
VIVIPARA.		GREEN SAND.
	extensa? 31	ditto
	fluviorum	Sussex marble.
	lenta	London clay.
	concinna	ditto
	suboperta	Crag.
DIANCHORA.		GREEN SAND.
	striata 80	ditto
	lata	Lower chalk
TURRILITES.		GREEN SAND.
	costata 36	Green sand. Chalk marl.
	obliqua 75	Green sand.
	tuberculata 74	Chalk marl.
	undulata 75	ditto
SCAPHITES.		GREEN SAND.
	equalis 18	ditto
	obliquus	Chalk marl.
NUCULA.		CHALK MARL.
	pectinata 192	ditto
	minima	London clay.
	similis	ditto
	Cobboldiæ 180	Crag.
	lanceolata	ditto
	lævigata	ditto
MAGAS.		CHALK.
	pumilis	Upper chalk.
INFUNDIBULUM.		LONDON CLAY, SAND UNDER
	echinulatum	ditto
	obliquum 97	ditto
	rectum	ditto
	tuberculatum	ditto
	spinulosum	ditto
	rectum	Crag.
PECTUNCULUS.		LONDON CLAY.
	plumstediensis 27	ditto
	costatus	ditto
	decussatus	ditto
EMARGINULA.		LONDON CLAY.
	crassa 33	ditto
	reticulata	London clay. Crag.
CYPRÆA.		LONDON CLAY.
	oviformis 4	ditto
OLIVA.		LONDON CLAY.
	Branderi 288	ditto
	Salisburiana	ditto
ANCILLA.		LONDON CLAY.
	aveniformis 99	ditto
	turritella	ditto

Genera.	Species.		Strata.
CASSIS.			LONDON CLAY.
	striata	6	ditto
	carinata		ditto
	bicatenatas	151	Crag.
AMPULLARIA.			LONDON CLAY.
	acuta	284	ditto
	patula		ditto
	sigaretina		ditto
NATICA.			LONDON CLAY.
	glaucinoides	5	ditto
	similis		ditto
	depressa		Crag.
ROSTELLARIA.			LONDON CLAY.
	lucida	91	ditto
	rimosa		ditto
	macroptera	298	ditto
SCALARIA.			LONDON CLAY.
	semicostata	16	ditto
	acuta		ditto
	similis		Crag.
TEREBELLUM.			LONDON CLAY.
	fusiforme	287	ditto
SERAPHS.			LONDON CLAY.
	convolutus	286	ditto
PLEUROTOMA.			LONDON CLAY.
	attenuata	146	ditto
	exorta		ditto
	rostrata		ditto
	acuminata		ditto
	comma		ditto
	semicolon		ditto
	colon		ditto
CERITHIUM.			LONDON CLAY.
	melanoides	147	ditto
	geminatum	127	ditto
	pyramidale		ditto
	funatum	128	ditto
	funiculatum	147	ditto
	intermedium		ditto
	dubium		ditto
	cornucopiæ	188	ditto
	giganteum		ditto
FUSUS.			LONDON CLAY.
	longævus	65	ditto
	bifasciatus	228	ditto
	acuminatus	274	ditto
	asper		ditto
	rugosus		ditto
	bulbiformis	291	ditto

Genera.	Species.		Strata.
VOLUTA.			LONDON CLAY.
	magorum	290	ditto
	luctator	115	ditto
	ambigua		ditto
	spinosa		ditto
	costata	290	ditto
	magorum		ditto
	Lamberti	119	London clay. Crag.
MUREX.			LONDON CLAY.
	latus	35	ditto
	Bartonensis		ditto
	trilineatus		ditto
	coniferus	187	ditto
	regularis		ditto
	carinella		ditto
	fistulosus	189	ditto
	gradatus		ditto
	tuberosus	229	ditto
	minax		ditto
	tubifer	189	ditto
	cristatus	230	ditto
	coronatus		ditto
	rugosus	199	ditto
	curtus		ditto
	striatus	22	Crag.
	contrarius		ditto
	rugosus	34	ditto
	corneus	35	ditto
	costellifer	199	ditto
	echinatus		ditto
VENERICARDIA			LONDON CLAY.
	planicosta	50	ditto
	deltoidea	258	ditto
	carinata	259	ditto
	senilis	258	Crag.
SANGUINOLARIA.			LONDON CLAY.
	Hollowaysii	159	ditto
SOLEN.			LONDON CLAY.
	affinis	3	ditto
TEREDO.			LONDON CLAY.
	antenauta	102	ditto
BALANUS.			LONDON CLAY.
	tesselatus	84	ditto
	crassus		ditto
BUCCINUM.			CRAG.
	elongatum	110	ditto
	granulatum	110	ditto

Genera.	Species.	Strata.
BUCCINUM.		
	rugosum	Crag.
	reticosum	ditto
EBURNA.		CRAG.
	{ *glabrata* O.R. III. 5, 25 }	ditto
TELLINA.		CRAG.
	obliqua 161	ditto
	ovata	ditto
	obtusa 179	ditto
PHOLAS.		CRAG.
	cylindricus 198	ditto
PHASIANELLA.		SAND ABOVE LONDON CLAY.
	orbicularis 175	ditto
	minuta	ditto
	angulosa 178	ditto
LYMNEA.		SAND ABOVE LONDON CLAY.
	fusiformis 169	ditto
	minima	ditto
CYCLAS.		SAND ABOVE LONDON CLAY.
	deperdita? 162	ditto
	cuneiformis	ditto
	obovata	ditto.

The following LIST of FOSSILS of the MOUNTAIN LIMESTONE and the TRANSITION LIMESTONE near CORK, kindly communicated by Mr. Miller, the Author of the *Natural History of the Crinoidea,* is, in many respects, extremely valuable, and particularly, from its showing the general accordance of the Fossils with those of the corresponding formations of this Island.

Fossils of the Mountain Limestone, near Cork.

Nautilus, an unfigured species deeply umbilicated, showing from three to four volutions; septa slightly undulated.

Ellipsolites ovatus, Sowerby, *Tab.* xxxvii.

. . . . . . *compressus,* Sow. *Tab.* xxxviii } These two *Ellipsolites* are evi-
. . . . . . *funatus,* Sow. *Tab.* xxxii } dently compressed *Ammonites.*

Orthocera striata, Sow. *Tab.* lviii.

Euomphalus pentangularis, Sow. *Tab.* xlv, *fig.* 1, 2.

Cirrus accutus, Sow. *Tab.* cxli, *fig.* 1.

Natica, undescribed.

Cardium hibernicum, Sow. *Tab.* lxxxii, *fig.* 1, 2.

Terebratula lateralis, Sow. *Tab.* lxxxiii, *fig.* 1.

Spirifer cuspidatus, Sow. *Tab.* cxxx.

. . . . *pinguis,* Sow. *Tab.* cclxxi.

. . . . *trigonalis,* Sow. *Tab.* cclxv.

. . . . *striatus,* Sow. *Tab.* cclxx.

Productus scabriculus, Sow. *Tab.* lxix, *fig.* 1.

. . . . . ., undescribed; frequently much compressed.

Trilobite, similar to that in mountain limestone near Bristol.

Platycrinites lævis, Miller's *Crinoidea,* p. 74.

Round crinoidal columns of a *Cyathocrinites?*

Amplexus corralloides, Sowerby, *Tab.* lxxii: this has no claim to be considered as a multilocular shell, but is a coral approaching to the genus *Caryophillia.*

Flustra, assuming sometimes a conic funnel-shaped form.

Turbinolia.

Transition Limestone.

Orthocera anulata, Sowerby, *Tab.* cxxxiii; Park. *Org. Rem.* Vol. III, *Pl.* vii, *fig.* 14.

...... *circularis*, Sow. *Tab.* lx, *fig.* 6 and 7.

...... *pyramidalis?* Fleming's *Annals of Phil. Misc.* 1815.

...... *sulcata*, ibid.

Conularia quadrisulcata, Sowerby, *Tab.* cclx, *fig.* 2 to 6.

Euomphalus rugosus, Sow. *Tab.* lii, *fig.* 2.

...... *discors*, Sow. *Tab.* lii, *fig.* 1.

...... *angulosus*, Sow. *Tab.* lii, *fig.* 3.

...... *(Delphinula)*, Park. *Org. Rem.* Vol. III, *Pl.* v, *fig.* 18.

Helix striatus, Sow. *Tab.* clxxi, *fig.* 1.

Tubulites geniculatus naturforscher, Sow. *Tab.* iv, *fig.* 2.

Pentamerus Knightii, Sow. *Tab.* xxviii.

...... *Aylesfordii*, Sow. *Tab.* xxix.

...... *lævis*, Sow. *Tab.* xxviii.

Terebratula, with the perforated beak not incurved.

Trilobite, Park. *Org. Rem.* Vol. III, *Tab.* xvii, *fig.* 11, 14, 19.

.... *Tab.* xvii, *fig.* 17.

Cyathocrinites rugosus, Miller's *Crinoidea*, p. 89.

Rhodocrinites verus, Mill. *Cronoidea*, p. 106.

Actinocrinites? moniliformis, Mill. *Cronoidea*, p. 115.

Tubipora catenulata, Park. *Org. Rem.* Vol. II, *Tab.* iii, *fig.* 4 to 6.

Astrea lithostrotion, a larger species than *Astrea basaltiformis* figured by Lhwydd and Parkinson.

Madrepora truncata, Park. *Org. Rem.* Vol. II, *Tab.* v, *fig.* 2.

Madreporite, Park. *Org. Rem.* Vol. II, *Tab.* vii, *fig.* 3.

.... *Tab.* vii, *fig.* 10.

Favosites.

Order of Arrangement of Shells in the different Formations.—It has been conjectured by some naturalists who had become convinced of the comparatively late creation of land animals and of man, that the peopling of this planet had commenced, in the enduing with the principles of life, beings of the simplest forms and organization; and, that by the influence of certain external causes, acting through passing ages, those changes had been gradually wrought in succeeding animals, from which have resulted the numerous differences which constitute the various tribes: rising from the almost lifeless sponge to the highly complex and more perfect animal, man. On this hypothesis it might have been expected that those beings which had possessed life under its most simple modifications, would be found in the earliest formed strata; and that, in proportion to the lateness of the period at which the strata were formed, would be the degree of complexity in the organization of the inhabitants whose remains they would contain. But investigation has ascertained, and the preceding table manifests most decidedly, at least, with respect to the class of animals of which we are now treating, that such a conjecture is ill founded. In the carboniferous and the mountain limestone are the remains of shells of the earliest creation, which are unexpectedly found, with hardly an exception, to exceed, in complexity of structure, all the shells which have been discovered, either in any subsequent formation, or living in our present seas. It is in this early creation that those shells are found which possess that complicated structure, very rarely found in the shells of this day, which enabled their inhabitants to rise and sink with them in the water. Such are the many-chambered univalves, the *Nautilus*, *Ammonites*, *Orthocera-*

tites, &c. The bivalves and multivalves of that era also seem to have been endued with a similar property. The curious structure of *Spirifer*, *Pl.* VII, *fig.* 15, and the multilocular construction of *Productus* of Martin, *Pl.* VII, *fig.* 13; of *Pentamerus*, *Pl.* X, *fig.* 7; *Amplexus*, *Pl.* VI, *fig.* 16, and of *Conularia*, *Pl.* VI, *fig.* 17, imparted, in all probability, to their inhabitants, a power of a similar kind. The fissure, noticed in one of the valves of the shells, bearing a close analogy with the *Productus* of Martin, and figured, *Organic Remains*, Vol. III, *Pl.* XVI, *fig.* 10, may, with reason, be supposed to have been also part of an arrangement for enabling the animal to accomplish a corresponding process.

But the existence in the mountain limestone, and others of the early strata, of shells bearing the form of the snail-shell, is a circumstance so apparently contradictory to the notions which have been just suggested, and, indeed, to opinions which are very generally entertained, that it should not pass as supported by the authority of Mr. Sowerby, without determining how far that authority has been given.

The first fossil of this kind, which is noticed by Mr. Sowerby, is *Helix Carinatus* (*Min. Conch. Tab.* X), found in the grey limestone, near Settle in Yorkshire; after which he saw the cast of a shell found in the micaceous sand formation near the Devizes, *Helix Gentii*, of which he says:—“I presume it to be an *Helix*, as somewhat according with *Tab.* X.” But on the subsequent examination of two other fossils of the mountain limestone, Mr. Sowerby was led to observe:—“Had not the general form strongly resembled the *Helix* abovementioned, I might have been induced to have placed this as a *Trochus*, although it does not positively accord with the characters of that genus. I might have formed a new genus of the two, to which the following species should have been added, did they not differ materially from each other in the characters which should distinguish it: besides, the aperture is very imperfect in them all. It is probable that other species may be found, and that by their help, and that of more perfect specimens, the genera they belong to may be determined, or the characters of new ones ascertained; and this is the more desirable, as they appear from their localities to be marine inhabitants, rather than land shells *."

In consequence of the agreement in form of the first mentioned shell with the latter ones, they become all involved in the same ambiguity: possessing the exterior characters of the snail-shells of the present day, and being imbedded among the earliest shells, those which possessed the power of rising and sinking themselves in the water. But a question here arises, and it is presumed that on these subjects, involved in the darkness of distant ages, questions and conjectures founded on analogy may be allowed: May not these shells have been actually of a genus different from *Helix;* and might not they have been furnished with such a structure as gave them the same powers as were possessed by their associates?

This conjecture derives support from the fact, that shells of such a description exist even now in the seas of the warm climates. Such is *Ianthina, Pl.* V, *fig.* 23: this shell had always been considered as a *Helix* by Linnæus, and by his successors, until the time of Lamarck, who determined it to be necessary to place it in a distinct genus. He ascertained that the inhabitant of this shell differed essentially from the snail. That organ which would by its situation be considered as the foot in the snail, was found not to be formed for crawling but for swimming; being covered with air bladders which could be filled or emptied according to the impulse of the animal. The shell, which is very thin with four whirls in its spire, is, like the fossil shells of the same form found in the mountain limestone, striated both longitudinally and transversely, and, as if to diminish its gravity, possesses no solid columella*. When the sea is calm, the Ianthines, it is said, are seen, in great numbers, swimming on the surface of the sea with their shells reversed, by means of their distended air-bladders; but on the sea becoming agitated, the air in the bladders is absorbed, the animals contract within their shells, and the whole immediately sink.

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* Min. Conch., Vol. II, p. 159.

This power is, indeed, possessed by other shell animals of the present day, besides the Ianthines; the *Lymnæa Stagnalis (Le Grand buccin de Geoffroy)* is known to swim on the surface of the water in a reversed position, and, when desirous of returning to the bottom, it compresses itself within the shell, thus expelling the air which had supported it; and, by this simple process, sinks immediately to the bottom.

The opinion that these shells of early creation, bearing the external characters of snails, might have been natant animals, having the power of swimming to the surface, like their associates, derives some confirmation from analogy; since the multilocular, natant shells are not only found in their own peculiar forms, as *Nautili, Ammonitæ,* &c., but have also assumed the peculiar form, as in *Turrilites,* of unilocular, turriculated shells, which do not appear to have been created until a much later period.

In the lias formation, which succeeds to the mountain limestone, the contained fossils differ considerably from those which preceded them: only a few species of

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[*] This is also the case with *Cirrus*, and, perhaps, with *Euomphalus*.

some of the multilocular univalves, and of the terebratulas, being here discoverable. The fossil shells found in this formation chiefly consist of bivalves of the genus *Ostrea*, *Gryphæa*, *Plagiostoma*, *Plicatula*, *Avicula*, *Mya*, and *Cardita*, with the single trochiform shell, *Trochus Anglicanus* of Lister, not perhaps met with in any of the succeeding strata; a shell of the genus *Helicina*, and the first simple unilocular shell bearing a turriculated form, being a species of the genus *Melania*.

In the strata above the lias, belonging to the Under Oolite, as well as in those of the Middle and Upper Oolite, including the Cornbrash, Kelloway Rock, &c. numerous genera are found which are not known in the preceding subjacent formations. The small proportion which the univalves bear to the bivalves, which was observable in the preceding formation, is here more obvious. Various species are found of *Pecten*, *Lima*, *Astarte*, *Trigonia*, *Lutraria*, *Mytilus*, *Modiola*, *Venus*, and *Isocardia*, with the tubular shell *Vermicularia*, and the single univalve *Solarium*.

In the superjacent green sand formation, including the whetstone of Devonshire, many new genera of bivalves are found: *Cardium*, *Corbula*, *Perna*, *Dianchora*, *Nucula*, *Venericardia*, occur here, with the simple turriculated shells of the genus *Turritella*, and the subglobose univalve, *Auricula*. Here, also, are first found the multilocular turriculated shells of the genus *Turrilites* and the hooked shells of the genus *Hamites*.

The blue marl and the chalk marl which next supervene, display the genus *Scaphites* and *Inoceramus*, with the oval multilocular shells, distinguished in this work as *Ammonellipsites* and *Nautellipsites*, and some other curiously formed multilocular shells much resembling, in their general characters, *Nautili* and *Ammonitæ*; and deriving their peculiar forms, perhaps, merely from compression.

The chalk, although containing many interesting species of the genera which had appeared in preceding strata, has perhaps only two genera of shells which originated in the waters by which it was deposited, *Crania* and *Magas*.

The fossil shells which are found in the immense stratum of blue clay resting on the chalk, manifest that a considerable difference existed between the inhabitants of the waters by which the two formations had been deposited. Hardly a shell is to be found in the blue clay of any genus which has been seen in the chalk. The waters from which the clay and the succeeding crags proceeded, appear to have been chiefly stored with testaceous animals differing from any which had been before in existence. This formation is remarkably characterised by the simple univalves, which in the preceding formations had existed, comparatively, in small numbers, but which now seem to have come into existence in a very predominant superiority. A slight view of the shells of this formation, with occasional reference to those of the preceding formations, it is presumed, will lead to interesting and useful conclusions.

Of the multilocular univalves, or of the bivalves of complicated structure, occurring so frequently in the earlier formations, perhaps none are to be found in the blue clay except such as have been dislodged, by alluvial action, from the early matrices in which they had been originally imbedded. About thirty-two genera of bivalves had been found in the more antient strata, and only five or six new genera have been found in the blue clay; but, on the other hand, the more antient strata had been found to contain only twelve or fourteen genera of simple turbinated or turriculated univalves; whilst the blue clay, and its accompanying sands and crag, have yielded thirty-two genera of turriculated shells: twenty-five of which, with about sixteen other genera not known to have yet existed in a mineralised state, people the waters of the present world with the myriads supplied by their numerous species.

We hence learn, that almost all the waters from which have proceeded strata containing testaceous remains were inhabited by genera, many of which, though multiplied in numerous species, and in myriads of individuals, have become entirely extinct; the proofs of their having existed being only to be traced in their entombed and mineralized remains. We thus also learn, that, in the succeeding waters, new and totally different beings filled the deficiencies which had been thus occasioned. These circumstances, observed in all, is more distinctly manifested in the later formations of the chalk and blue clay. Of the genera of fossil shells which exist in the chalk, hardly an individual can be detected in the blue clay; but in their places are found the remains of shells not known to exist in any of the preceding strata. Investigation has ascertained them to be the remains of an entirely new series of animals; not formed by the gliding of one genus into another, or by changes induced in the structure of the animals by the gradual and continued agency of external circumstances; but, as far as the state of our knowledge will allow us to judge, by a new creation, adapted to the nature of the fluid, for the peopling of which it was decreed; and to the especial purposes which Providence had destined it to accomplish in future ages.

Links varying from each other by minute determinate characters, and secured in their integrity, and in their connection with each other, by certain laws decreed at the beginning, are, in all probability, the notions which are in general conveyed by the figurative expression of the chain of creation: the loss of a single link being supposed to be productive of disturbance, and ultimately of the annihilation of the whole.

By those who have been misled by this figure to the adoption of the idea of a concatenation of beings dependent on each other for their existence, the opinions now proposed must be rejected. They are, however, it is hoped, most accordant with a reverential idea of the great Creator; who is thus supposed to have conducted from the beginning, and to be still directing, the affairs of the world, by a special care and providence, to the termination of some certain period, and for the accomplishment of great and important purposes.

The geological enquirer will derive some assistance from the examination of fossil shells, whilst endeavouring to ascertain how far the earth contained in the testaceous and crustaceous coverings of marine animals has contributed to the formation of calcareous rocks. It has been conjectured, that besides adding to the bulk of the limestone or chalk by the accumulation of their remains still bearing their original forms, that they have also contributed to the surrounding matrix by a solution and subsequent precipitation of the lime which had entered into their composition. If this had been the case, we might expect to find those remains which still bear their original forms, manifesting every degree of resolution, from the slightest influence of the agent in destroying the finest striæ to the smoothing of ridges, and even the diminution or removal of projecting points. But nothing of this is discoverable in the fossils of either the flint, the limestone, or the chalk. In the latter, which, by the fineness and purity of its substance, gives strong evidence of its having been deposited by precipitation, not the slightest appearance of chemical action on its contained fossil shells is observable. If preserved at all, they are preserved with their sharpest ridges and minutest points in the most perfect state.

Shells of alternating Marine and Fresh-water Formations.—On examining the crags, the beds of gravel and fossil shells lying over the London clay, numerous fossil shells are found approximating in their characters to the recent shells of our present seas. These, it has been supposed, are the remains of the inhabitants of that sea which covered, at a very distant period, the surface of the planet, and which were left by it when it was withdrawn to its present level. On this point no decisive opinion can be offered: it cannot, however, fail to call to our contemplation the consequences of that revolution which this planet sustained, when its surface was broken up, and extensive tracts entirely removed, even to the solid granite, by the inconceivable agencies of Divine power.

To give to the world, formed anew from the shattered fragments of that which preceded it, that state and form which were requisite for the purposes to which it had been decreed by the Almighty, numerous and extensive operations must have been ordained; and from some of these, it is not improbable that the phenomenon just mentioned may have resulted; and to similar causes may, perhaps, be referred numerous other phenomena observable in the structure of the earth. One of these, the appearance of considerable tracts, bearing marks of the sea and fresh water having borne alternate sway over them, demands the earnest attention of those who have engaged in these studies.

That the tracts here referred to have been formed partly by deposition from fresh water, is supposed to be proved by the near agreement of many of the fossil shells which they contain, with those which are now to be found actually living in our rivers and marshes, and on the surface of the earth. The first of these, considered as the lower fresh-water formation, is found over fossil sea shells: and in France, with alternate beds of gypsum and of marl, and with the remains of land animals which, it is supposed, inhabited the borders of the lakes in which the inhabitants of those shells lived. Above this formation are found marine shells, and above these, another fresh-water formation.

From these facts M. Brongniart inferred that these different beds demonstrated the repeated alternations of sea and of fresh water on the same tract; and that, at the period when the sea was forming marbles, schists, &c., the fresh-water lakes might also have had the quality of depositing stony beds, such as gypsum, fresh-water marbles, &c., and of enveloping in them the animals and vegetables which lived in these waters, or on their borders. But, whilst forming these opinions, M. Brongniart found it necessary to admit that the formation of gypsum might also have taken place both in fresh and in salt water; and was obliged to allow, that in some places, as in the quarries of Beauchamp, the river and the sea shells are really mixed together.

These opinions, particularly as to the alternation of deposition, have been strongly opposed by Messrs. de la Metherie, Brard, and Faujas St. Fond. By the first of these it is said, that as land shells are found in these formations, they, as well as the bones of the land animals, must have been carried in by currents; and, therefore, it is probable, that the fresh-water shells might also have been carried into the sea in the same manner, and thus have formed the present beds. M. Brard and Faujas St. Fond are of opinion, that all shells, previous to these depositions, existed in water of the same nature; but that, in the process of time, perhaps from the increase of the saltness of the sea, a separation took place, the inhabitants of the shells which are at present found in fresh water, or on land, having migrated to situations more congenial to their nature[*]. M. Faujas St. Fond, too, having found *Ampullariæ* and *Melaniæ*, with a shell much resembling those of the genus *Planorbis* in bituminous marl between beds of coal, concluded that their presence here could only be accounted for by supposing them to have been brought by the torrents of an overwhelming sea; and takes the opportunity of thus attacking Cuvier, who had pointed out the errors he had committed whilst describing some of the fossils of Maestricht. "Those (he says) who please themselves with their systems of lakes, finding here the remains of various animals, suppose that these animals of the burning zones had their dwellings on the sides of these lakes, where they came to quench their thirst: that the peaceable stag, the fragments of whose antlers are found petrified by the side of the large, the medium, and the small *Paleotheriums*, lived here in company with animals equally unsociable; and that the borders of these charming fresh-water lakes, shaded by African or Asiatic palms, were the delightful asylums of animals of such opposite genera: for it was not possible to deny the existence of these palms, said those who possessed these grand ideas, since there had been found some pieces of petrified trunks above, as well as beneath, the remains of these quadrupeds. No more, in a word, was wanting than to bring into this scene, birds who should come to drown themselves and then to become incrusted with gypsum, to complete a zoological collection, unique in its kind; and thus to deny to the waters of the sea the power of producing equally astonishing accumulations of fossil organic bodies[†]."

With the hope of ascertaining which of these hypotheses had the best foundation, recourse was had to more strict examinations of the fossil shells which had been discovered in these fresh-water tracts, which led to the proposal for a more illustrative arrangement of them.

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[*] Annales du Mus. Tom. XIV, p. 314.

[†] Ibid. Tom. XV, p. 153.

M. Brard, upon examining the masses containing *Lymneæ*, *Planorbes*, and other fresh-water shells, found also shells which had hitherto been considered as sea shells, a species of *Cerithium*, for instance; and remarks, that this circumstance had been passed silently over by Brongniart and Cuvier. He adds too, that these supposed fresh-water shells are sometimes found scattered among a multitude of acknowledged sea shells, as, *Oysters*, *Venus's*, &c. He, also, in answer to M. Brongniart's having asserted that these fossil shells "were alike in every respect to those which we find in our marshes," declares that they differ decidedly; that there is not one of them whose living analogue is to be found among the fresh-water shells of France; and observes, that *Bulimus pygmæus*, whose fresh-water origin had been assumed, agrees, in some respects, with shells found in the calcareous rocks of Mayence, and which had been supposed to have been of fresh-water origin; but the living analogues of which Faujas St. Fond had found on the shores of the French ocean and of the Mediterranean Seas, as well as in some of the salt-water marshes. M. Brard adds, that in five places out of six where he had found the *Lymneæ*, &c. they were imbedded in isolated blocks, which, he supposes, had been broken up from the sides of the waters where these animals had lived, and had been brought to these places by a diluvial torrent*.

On the other side, M. Brongniart, in proof of the agreement of these fossil shells with the recent, states his having found amongst them the cast of a *Cyclostoma*

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* Annales du Mus. Tom. XV, p. 366.

elegans, and mentions several of these shells which he thinks very nearly agree with recent species. M. Brard having figured and described a species of *Melania*, *Melanie effilée*, as existing among these fresh-water shells, M. Brongniart says, that he discovered, by his own examination, what he should never have found by M. Brard's description or figure, that this sea shell was *Cyclostoma mumia*, a land shell: and as to the *Bulimi* of Faujas St. Fond, both those which were found fossil and recent, he was satisfied were also *Cyclostomæ*. But, with respect to the *Cerithium* mentioned by Brard, he denies its being a sea shell, and finds it necessary to consider it as belonging to the marshes adjoining the sea, or to the salt water of the mouths of rivers: and finding other species as having been said to be found in these situations, he thinks it necessary to form a genus for their reception, founded rather upon the habits of the animal than on the characters of its shell. Thus we arrive at the first of these supplementary genera.

Potamides.—A turriculated shell; opening nearly semicircular, pinched up, as it were, at the base of the columella, and terminated by a very short, straight canal, which is hardly grooved; no groove at the upper extremity of the right side, but the outer lip dilated.

Of the particular shell mentioned by M. Brard, he makes a species of this genus, and terms it *Potamides Lamarckii* *. By thus dividing genera into those of sea, of land, &c., M. Brongniart expects to prevent its being concluded that these *Lymneæ*, &c., were sea shells, or that revolutions of which, he says, there exists no trace, carried these fresh-water shells into the ocean, and mixed them with the sea shells.

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* This conciliatory compliment to M. Lamarck appears to have been by no means unnecessary. For those who attempt to explain the circumstance of the mixture of sea, river, and land shells, by their having lived in a common medium, contend for the difficulty of distinguishing the difference between these shells; whilst those who contend for alternations of sea and fresh water, think the practised conchologist might find but little difficulty: yet Lamarck, after examining and naming sixty species of *Cerithia*, says decidedly, "*Les Cerites vivent toutes dans la Mer;*" but now another genus is formed of several species of fresh-water shells out of these, showing, certainly, that the distinction cannot be easily made.

Brongniart and Cuvier had founded their opinion of the fresh-water origin of the upper beds of gypsum, chiefly on the presence of a shell found in the gypsum, which appeared to be a *Cyclostoma*, and was supposed to be a fresh-water shell. Of these shells two only were found in the gypsum; one of which, in the possession of Brongniart, had its mouth unluckily concealed; but the other, in the possession of Faujas St. Fond, as fortunately, had it displayed so as to show that it agreed with *Cyclostoma mumia* of Lamarck, who had only named it so provisionally, since, from its thickness, he had supposed it to be a sea shell. M. Brard hence concludes, that the fresh-water origin of the gypsum does not derive any support from this shell *.

He describes, as existing among the marine fossils of Grignon, two minute land *Bulimi*, the conical and pyramidal; and one still more minute, the cylindrical, which approaches in form to many of the small species of *Pupa*. This shell has six turns, very projecting, deeply separated, and derives a cylindrical form from the last three turns being nearly of the same diameter. He also mentions impressions and fragments of minute *Planorbes* among decidedly marine shells, and supplies a list of forty-eight river and land shells found by Lamarck among the fossil sea shells of Grignon.

But this mixture of these supposed land and fresh-water with sea shells, is not confined, according to M. Brard, to the lately discovered formations of the environs of Paris; since he has ascertained that they are found together in several other parts of France, at a considerable distance from Paris. Buxweiller, Mayence, Caen, Francfort, Orleans, Gergovia, the Brecciæ of Nice, the volcanico-marine valley, as it is called by St. Fond, of Ronca, and the island of Sheppey, are among those places in which he states them to have been found. Whilst speaking of the Brecciæ of Nice, he reprehends Cuvier for having entirely omitted to mention the sea shells which are found there, although he particularised the land shells, and this, after Faujas St. Fond had stated his having found there, *Turbinites* and *Serpulæ*, both marine shells.

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* Annales du Mus. Tom. LXXII, p. 448.

The shells of the valley of Ronca, as noticed by the Abbé Fortis, are very interesting, they being mostly filled with very minute shells. Their substance, too, is changed into lamellar carbonate of lime; and they are found to have acquired a considerable increase of thickness. From this frequent discovery of sea, river, and land shells thus mixed. M. Brard hopes that the opinion of their all having lived originally in a similar fluid is confirmed.

M. Brongniart, anxious to support the position, that the shells in the fresh-water and accompanying formations were separately deposited by the alternation of fresh and sea water, experienced, however, a considerable difficulty from Lamarck having already admitted that, among the accumulation of fossil sea shells in the environs of Paris, there were nearly fifty species which were referrible to land or fresh-water shells. To meet this, we have seen that he admits that these may have been derived from the mouths of rivers, and from the marshes adjoining the sea; and that it is therefore necessary that the genera already formed should be so subdivided, that genera should be established for the complete separation of sea, river, and land shells; a labour in which he said M. Lamarck was already engaged.

Cerithium, he observes, he has already divided into *Cerithium* and *Potamides*. *Turbo* is generally a sea shell, though sometimes found in ponds of salt water. The sea and river *Patellæ*, it is acknowledged, differ hardly at all in their shells, but must thus be placed in different genera: and the same must be remarked of the *Crepidulæ*, he, I believe, meaning *Calyptrea*. *Cyclostoma* must be divided into *Cyclostoma* for the land shells, and *Paludina* for the aquatic shells. Marine *Bulimi* must be separated from the land *Bulimi*, and be disposed in a new genus, or joined to *Phasianella*. *Melania*, *Auricula*, *Ampullaria*, *Planorbis*, and *Nerita*, all demand subdivision. *Pupa*, also, he says, requires subdivision; but, as in the case of *Patella*, the shells would be difficultly distinguishable.

The editor of the *Journal de Physique* for 1811 observed, " Les Naturalistes des autres Contrées, et particulièrement la Société Geologique de Londres, ne manqueront pas de faire des recherches analogues." The supposition of M. de la Metherie was soon verified by the interesting discoveries of similar formations in the Isle of Wight, by the highly judicious and zealous exertions of Mr. Webster, who not only pointed out a basin, probably of some ancient lake, formed in a depression in the chalk stratum, corresponding with that of Paris; but also showed that a very close agreement existed between the respective beds of the two basins, and that the beds in the Isle of Wight basin were lying above the London clay. He ascertained that the beds of shells of the several formations are to be found distinctly separate, but, as might be expected, sometimes mingled. He also pointed out the great basin of the London clay, and noticed the mixture of fresh-water shells with sea shells, which it contains; observing on *Lymneæ*, *Mela*-

niæ, and other fresh-water shells, being found in the Sheppey clay, "These shells (he says), which are however very few in number, do not prove the existence of fresh-water formations in this place similar to those in the basins of Paris and of the Isle of Wight. Being found among the remains of vegetables and marine animals, we may suppose that they were carried down together with the branches of trees and fruits, by the numerous streams and rivers that must have flowed into this gulph *."

That the shells in the Petworth marble are fresh-water shells, and that this formation existed in Hampshire, as well as in Sussex, appears to have been well known to Woodward. In his catalogue of marine bodies, chiefly shells, grouped together in lapideous masses, he mentions a mass with *Cochlitæ* in it, Petworth, Sussex; and says, they seem to have been moulded in the *Cochlea fasciata vivipara fluviatilis*, Listeri.

This marble, as he observes, has been employed in many of our cathedrals. The most antient coffin in Salisbury, that of, I believe, Kynrick the Saxon, which was removed thither from Old Sarum, and has been generally supposed to be of granite, is formed of this marble. This marble, we know, exists also at Purbeck.

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* Geological Transactions, Vol. II †.

† In a paper, read at the meeting of the Geological Society, on Nov. 2, 1821, it appears, that Mr. Webster having recently examined the Hampshire coast, found that Hordwell cliff was not formed of the London clay, as was generally supposed, and as he had stated, from the accounts of others in the former paper published in the Transactions of the Geological Society; but that it was composed of beds analogous to the lower fresh-water formation of the Isle of Wight. Under these beds, which dip to the east, is another of white sand; and below this, in the next cliff to the west, appears the bed similar to the London clay, and which contains the well-known fossils published by Brander. This forms also the inferior part of the coast still farther to the west, called the High cliff, which reaches nearly to Muddiford.

This series of beds being similar to those on the opposite side of the island at Headen Hill, Isle of Wight, is considered, by Mr. Webster, as affording a strong confirmation of the opinion he had formerly advanced respecting the extent of the Isle of Wight basin.

Mr. Webster also enumerates several fossil fresh-water shells which he found at Hordwell cliff, and, among other remains, are fossil capsules, or seed-vessels, in considerable numbers.—*Annals of Philosophy, March* 1822.

Dr. Nugent has, I think, pointed out a very important fact respecting these formations. In a siliceous specimen with which I was favoured by Dr. Nugent, from Antigua, several moulds may be seen bearing very strong marks of their having been filled by shells of the genus *Planorbis;* with a nearly perfect shell, whose mouth points it out as a species of the genus *Melania,* and whose size and finely rugated surface give it a close resemblance to *M. fragilis* of Lamarck. In this specimen, also, I think the opening of the *Melania* is apparent. I trust that the farther investigations of that gentleman will determine the existence of fresh-water formations in the West Indies*.

Insects.—The delicacy of the structure, and, indeed, the nature of the substance, which enters into the formation of those animals which are generally comprised under this term, render them so unfit to sustain those changes which would be necessary for the conservation or mineralisation of their remains, that very few become the subjects of our examination. The crustaceous coverings of the bodies and limbs, and the hard wing-cases of some of the genera, are the chief, and, perhaps, the only fossils which can be properly referred to this class.

The *Trilobites,* or Dudley fossil, the living analogue of which is at present unknown, and the original nature of which is so little understood, that it has, by some, been considered as a crustaceous insect, and, by others, as a bivalve shell, and has hence been designated, by Linnæus, as *Entomolithus paradoxus;* by Dacosta, as

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* For further illustration of this subject, the reader is referred to Mineral Conchology, No. LIX.

Pediculus marinus; by Hermann, as *Pectunculus trilobus imbricatus;* will demand the student's attentive investigation.

Its superior covering, *Pl.* X, *fig.* 1, which is the only part with which we are acquainted, is oblong, ovate, convex, and marginated; the anterior wider part is gibbous, and furnished with two semilunar tubercular projections resembling palpebræ; and posterior to, and on the inner side of each of these are two round tubercles. Adjoining to this part commences a series of triarcuated, imbricating, transverse slips, so disposed that the three bows of these connected slips form three longitudinal transversely divided lobes, gradually diminishing to the lower termination. In some specimens the fossil is almost globular, showing that the animal possessed the power of coiling itself occasionally in this form. No elongated caudal termination is seen in this species; nor in the published representations of any of the preserved remains of this animal have the traces of any organs of progressive motion been given; still it may be conjectured that this animal was furnished with articulated and unguiculated feet*. This fossil has been found in the neighbourhood of Dudley nearly three inches in length..

Another species is found in the schistose strata of Llandilo in Carmarthenshire. In these the outline of the animal approaches rather to that of a long ellipsis than to an ovate form: the lateral lobular divisions of the dorsal plates or slips are nearly three times as wide as those of the central part. The crustaceous coverings are, in these species, generally removed, leaving in some parts, however, a very accurate impression of the inner surface, with regularly disposed longitudinal minute rugæ, appearing as if they had been formed by the subjacent soft cuticle. *Organic Remains*, Vol. III, *Pl.* XVII, *fig*. 13.

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* I have seen the sketch (on the fidelity of which I think I can depend) of a fossil animal of this kind, corresponding, in its feet, with the above description; and have also seen a specimen of the animal at Clun, in Shropshire, in which I believed the points of the feet appeared from beneath the superior covering; but, on endeavouring to detach the piece of rock in which it was imbedded, and though working with the utmost care, the specimen was entirely shivered.

In another species, or, perhaps, approximating genus, on a grey limestone, the locality of which is not known, the head part differs materially from that of the preceding, it being nearly covered by three large round and rough protuberances, two of which possess the situation of the eyes, and the third, which is the largest, is placed anterior to and between these; but each appears to have possessed a similar porulous and granular structure. *Organic Remains*, Vol. III, *Pl.* XVII, *fig*. 16.

A third species, found by Thomas Botfield, Esq., of Hopton Court, Shropshire, in an iron stone nodule, differs much from either of the preceding:—"The head is large, semiorbicular, lunated posteriorly, and terminates at the sides in an acute angle. The body, which has only five transverse plates, is remarkably short; its sides going directly off from the head, and meeting speedily at an obtuse angle. From this part proceeds the tail of the animal, a long central spine-like process, which is of a greater length than that of both the head and body." *Org. Remains*, Vol. III, p. *267. This fossil appears to be the same with *Monoculites lunatus* of Mr. Martin, *Pl.* XLV, *fig*. 4, who supposed it to approach nearer, in size and figure, to the *Monoculum apus*, than to any other known recent species of that genus.

The remains of another species are found in the beds of fuller's earth, but the caudal termination of these have only been as yet described. This species appears from the form of its plates to have approached the nearest to that which is found in the Dudley limestone; but the dorsal plates gradually diminish in size, and, at last, finishing in an elongated caudal termination.

Mr. Benjamin Henry Latrobe relates, in the second volume of the American Philosophical Transactions, that among the fish resorting to the waters of the York River, the alewife or oldwife *(Clupea nondescripta)* arrives, in very considerable shoals, from March to May. In this season each of these alewives carries in her mouth an insect, about two inches long, hanging with its back downwards, and firmly holding by its fourteen legs to the palate. The fishermen call this insect the louse. Mr. Latrobe names it *Oniscus prægustator*.

Whether our unknown fossil animal had antennæ or feet, as I suspect, or not, cannot perhaps be determined, and therefore the characters of an *Oniscus* cannot be claimed for it; and yet the structure of its body, with its transverse imbricating slips, is so much in agreement with this living insect, as to induce me to place the figure of the latter before the reader, (*Pl.* X, *fig.* 2,) with the hope of its leading to a more successful investigation as to the origin of the fossil.

Lhwydd relates that he found, in coal slate, the fossil remains of spiders, and other remains approaching, in their forms, to those of *Scarabæi*. In the Stonesfield oolitic slate are impressions with a slight brownish stain; the origin of which has not yet been ascertained. They bear a figure which somewhat resembles, in its outline, that of the figure by which a crown is represented: by some they have been considered as bearing a resemblance to two united wings of a butterfly; and, by others, have been supposed to have been the impressions of the detached plates of some species of tortoise.

We find, in the invaluable work of the Rev. W. D.

Coneybeare and W. Phillips, speaking, most probably, in reference to these fossil remains, that "specimens, which have been decidedly pronounced, by Dr. Leach, to be the *Elytra* of *Coleopterous* insects, occur in the Stonesfield slate; they are of two or three different species*."

In the yellow fossile limestone of Pappenheim, Oeningen, &c., are found the remains of insects; but these are also in such a state as will not allow their generic characters to be ascertained. The head, which is very indistinct, appears to have been connected with the trunk by a very contractile neck. The thorax is shorter and thicker than the abdomen, which is of a lanceolate form, and separated into eight divisions by annular risings. Neither wings nor legs are discoverable.

Crabs.—The number of fossil crabs is very considerable. They are found in the Stonesfield slate, and in the limestone of Pappenheim, &c. It is stated by Knorr, that the remains of cray-fish, *Astaci*, are found only in a narrow district, reaching from Gunzenhausen, in Anspach, to Aichstaedt, a length of about seven or eight leagues, bordered on one side by the river Altmuhl. The matrix of these fossils is evidently a portion of the same stratification which occurs at Pappenheim, &c. in which the remains of fishes are so frequently discovered. Crabs and lobsters are frequently found in the London clay. In the London Museum there were more than thirty species of crabs from the Island of Sheppey; and Mr. Donovan, the proprietor, who also possessed, perhaps, one of the finest collections of the recent animals in this kingdom, was satisfied that he had no recent analogue of any of the species in his fossil collection. Verona, Malta, and Anjou, produce these fossil remains: they are also found imbedded in a hard, light coloured, pyritous, and argillaceous stone, resembling indurated London clay, from some parts of China.

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* Outlines of the Geology of England and Wales, by the Rev. W. D. Coneybeare and W. Phillips, Vol. I, p. 208.

Birds.—Their remains are very rarely found in a fossil state. Bones, which may be considered as referrible to this class, are, however, imbedded in the calcareous schist of Oeningen, and in the oolitic schist of Stonesfield. The foot of a bird has been found incrusted in gypsum, near Montmartre; Blumenbach describes the bones of a water-fowl in the Pappenheim stone; and Faujas St. Fond has figured two feathers found in the calcareous stone of Vestena Nuova.

Cuvier, whose zealous exertions are always conducted by science, has not only ascertained the existence of fossil remains of this class, but has furnished the student with information which must aid him in his investigations with respect to these fossils. The foot, he observes, in birds, has a single bone in the place of the tarsal and metatarsal bones. Birds, too, form the only class in which the toes all differ as to the number of joints, and in which this number, and the order of the toes which have them, is nevertheless fixed. The great toe has two; the first toe, reckoning on the inside, three; the middle, five; and the outermost five. The crocodile has the same number of phalanges; but, as these have a tarsal and metatarsal bone, they cannot be mistaken. Some birds have no great toes, but, in these, the other toes preserve the usual order: the ostriches and cassowars have three toes. Although the crocodile has the same number of phalanges, yet, as every one of the toes is supported by a particular metatarsal bone, the distinction is easily made.

From an attention to the different specific characters, Cuvier ascertained the existence of the remains of five or six different species of birds in the plaster quarries near Paris. Among these are the bones of a pelican, less than *Pelicanus onocratulus*, and larger than *P. carbo;* of one of the larger curlews, with a naked neck (*Tantalus*, Gmelin); of a woodcock, a starling, and a sea-lark (*Alouette de Mer*).

He also describes and figures a bird, found in the quarries of Montmartre, which appears to have fallen on its belly on the newly-formed gypsum, without having been quite involved in it; and having, probably whilst in this state, been deprived of its head and the whole of the right leg. The result of a careful examination of this fossil is, that it belongs to some exotic quail, rather larger than the one known in France.

Fishes.—The fossil remains of fishes are found in such various states, under such different circumstances, and in the formations of such distant periods, as cannot but lead the zealous inquirer to expect that he shall derive, from their examination, information of considerable importance.

The fish, in some specimens, are found nearly entire; the harder parts all in their natural situations, with their scales, and even their skin, preserved. In others, all the other parts are removed except the skeleton; the bones of which either retain their original relative situations, or have undergone considerable distortion, and even dislocation. In some instances, not only separation of these parts has taken place, but the greater part of the skeleton has been removed; the harder parts, the grinding sulcated or tuberculated teeth having only remained. This circumstance may be accounted for by supposing that, in these instances, the fish were of the cartilaginous kind, and that their skeletons might have undergone that decomposition which these parts, from their structure or superior degree of hardness, had been able to resist. In other instances, the bones are found partly surrounded by a whitish, spathose, and rather opaque substance, which conjecture will be disposed to consider as being probably the flesh of the animal, which had been converted to adipocire, and subsequently mineralised by impregnation with carbonate of lime assuming a spathose state.

There is, perhaps, no class of animals the remains of which, found in a fossil state, are capable of being referred to so many living analogues. According to Mr. Lacepede, more than thirty Asiatic, African, and American species of fishes have been found fossil in the neighbourhood of Verona.

At Nanterre, near Paris, a fossil fish was obtained, nearly resembling *Coryphena Chrysurus*, Lacepede; another was found, by Faujas St. Fond, in the mountain on which the castle of Rochesauvre is built, which has been ascertained to be *Idus, pinna ani radiis* 13, *ventre plano*. Among these fossils are fish whose analogues live in the Indian Ocean, and in different seas of Africa, and of North and South America. M. Bozza, the proprietor of an immense collection of fossil fish collected from Monte Bolca, observes, that he possessed many whose living analogues were not known, and that, among more than a hundred which are known, there were four which are peculiar to the sea of Otaheite; *Polynemus Plebeius*, or Emoi of the Otaheiteans; *Gobius Striatus*, or Jaipoa; *Gobius Occellaris*; and *Chætodon Triostegus*.

The remains of the following fish have been ascertained to exist in a mineralised state in different parts of Italy, France, and Germany:—the pike, carp, perch, eel, sea-scorpion, mackarel, turbot, sword-fish, lod, *scarus*, *chetodon*, *balistes*, *gobius*, *fistularia* of Japan, and *pegasus* of Brazil. This list may be expected to be soon considerably extended, since some of the French naturalists, it is understood, are engaged in making the necessary investigations for enabling them to distinguish between those remains of this class of animals which are referrible to known and to unknown genera.

In the neighbourhood of Naples, in the Vincentine, at Pappenheim and Oeningen, near the lake of Constance; at Aix in Provence, and in numerous other places on the continent, the remains of fishes are found either in limestone, or in a yellowish or fawn-coloured calcareous fissile stone. At Eisleben, and in Mansfeldt, in Upper Saxony, fishes are found in a black schist; and the metallic appearance which they derive from the pyrites, with which they are imbued, renders them frequently very splendid and beautiful specimens.

Fishes are frequently found in a mineralised state in this island: their fossil remains have been found in a variety of situations, sufficient to warrant the conjecture that they were among those animals which were of the earliest creation, and whose existence has not been since interrupted.

It does not appear that any skeletons or any connected remains of fish have been found in the mountain limestone; sufficient detached parts have, however, been discovered to prove that fish existed in the waters by which this formation was deposited. The most interesting of these are the fossil remains which seem to be referrible to the spinous radii of some species of *Balistes*; or of some other genus which was armed with dentated radii, accompanying, or being in the place of fins *.

Another fossil which appears to have been obtained from this early formation, bears a considerable agreement with the sword of the *Xiphias*: the fossil alluded to is round and tapering, but has been broken at the smaller end before either of these maxillary processes had terminated. Two species of *Xiphias* have been described: in one, the elongated jaws or beaks are of a flattish form; in the other, to which the name *Makaira* is considered as most applicable, the beaks form a long, round, tapering weapon: it is with this latter species alone that the fossil referred to should be compared. But although it was thought right to mention this fossil as probably belonging to the mountain limestone, it is by no means meant to contend for its claim to this locality, since it has not the decided evidence of an adherent matrix.

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* I am indebted for an interesting fossil of this kind to the Rev. Mr. Hallifax.

The remains of fish are much more frequently found in the strata of the lias formation. They have been figured by Mr. Nicholls, in his *History of Leicestershire*, Vol. III, but the figures are so very indistinct as not to allow a well-founded conjecture on the genera to which they belong. The figure in the Rev. Mr. Townsend's work, although doubtlessly performed with every regard to fidelity, docs not convey any decisive information respecting the genus to which it may be referred. Two specimens are in the possession of the writer, contained in the lias in the neighbourhood of Lyme, which are flat and of a trigonal form, about twelve inches in length and nine in width, and are remarkable for their square, highly polished, black and comparatively large scales. One of the scales, detached and showing its root, is figured, *Organic Remains*, Vol. III, *Pl.* XVIII, *fig.* 9. In another specimen, several of these scales are involved in a nodule of lias from the neighbourhood of Whitby. These fishes, from the situation of their eyes not being discoverable, and from no traces of their fins appearing, afford no means of determining in what part of the icthyological system they are to be disposed*. Here are also to be found the armour, the spinous radii, of some fish, having fluted sides, terminating in a strong pointed extremity, and bearing sharply-pointed spines on their posterior sides. A very fine specimen of one of these fossils is figured in Mr. Townsend's work, "*The Character of Moses,*" *Pl.* XI. These are by no means unfrequent in this formation, and have, until lately, been considered as part of the jaw of an unknown animal. The leech-like palate teeth of some species of fish are also found in some of the strata of the lias. Numerous teeth, of a small size, are also found in these situations, very much resembling those of the shark; with others bearing the same form, but differing in their surface, which, instead of being smooth, is rendered rough by numerous grooves and ridges disposed in radiating and sinuous directions.

In the upper beds of the oolite, and particularly in the calcareous slate of Stonesfield, the remains of fish frequently occur. These are chiefly the hemispherical, or obtuse teeth, which, when changed by mineralisation, and possessing a dark brown colour, with a considerable polish, are named *Bufonites*. These are sometimes found imbedded in the Stonesfield slate, in the regular order and rows in which they were placed in the jaws of the animal, but without any of the surrounding bone in which they had been disposed. From this circumstance, and from such few vertebræ, and no skeletons having been found in these beds, may it not be presumed that these remains belong to fishes of a cartilaginous structure, the bones of which had been gradually removed, whilst imbedded? These fossil teeth,

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* It appears, that a paper by M. de la Beche, which was read at a meeting of the Geological Society, June 28, 1820, describes a fossil fish from Lyme, which appears to agree very nearly with those which are mentioned above. It is named, by M. de la Beche, *Dapedium politum*.

Bufonites, appear to be the round molar teeth with which the jaws and palates of fish of the genera *Anarrhicas* and *Sparus* are furnished. In *Pl.* I, *fig.* 11, 12, and 13, are represented teeth of other forms from the Stonesfield slate.

In the different beds which occur between those of the oolite and of the chalk formation, detached fragments of fish are sometimes found; and remains, still bearing the form of the fish, have been found in very good preservation in some of the Purbeck beds.

The chalk, in its several divisions, frequently manifests that fish abounded in the waters by which it was deposited. These remains are chiefly the different sulcated palates, detached vertebræ, and irregular masses with the scales of fishes. But it is with great satisfaction the reader is informed, that Mr. Mantell, of Lewes, in his forthcoming work, will evince the zeal and assiduity with which he has pursued his researches respecting these fossils in the chalk formation.

That gentleman has kindly informed me, that he has been enabled to ascertain the presence of the following fish in the chalk, near Lewes; and that plates of the several specimens are prepared for his work.

Teeth of
Squalus cornubicus.
——— *mustelus.*
——— *zygena.*
——— *galeus.*
Diodon, an unknown species of.
Balistes, an unknown species of.
Muræna Lewesiensis.
Anarrhicas lupus, molar teeth and jaws.
Salmo Lewesiensis.
Esox Lewesiensis.
Arnica? Lewesiensis.
Zeus Lewesiensis.

The remains of fishes are frequently found in the

London clay, in various degrees of preservation: not only are the numerous teeth of cartilaginous fishes found here in their various figures—triangular, conical, single pointed, tricuspidated, tridentated, lanceolated, &c., and from more than an inch in length to very small sizes—but others, belonging to spinous fishes, varying considerably in their forms and sizes, are found still affixed in their bony sockets. The skeletons of some of these fishes still remain, but so fixed in their hardened matrix as to be very difficultly separable.

The teeth are mostly referrible to different species of the genus *Squalus;* and are spoken of, by former writers, under the different appellations, *Plectronites, Rostrago,* &c. The bony tongue and palates of different species of the genus *Raia,* particularly of *Raia pastinacea,* are also found completely mineralised in this formation.

Ceti.—The fossil remains of whales are much seldomer found than might be expected. Part of the long projecting and spirally-twisted tooth of the Narwhal, improperly termed *Monodon monoceros,* exists in a fossil state, and, from its adherent matrix, appears to have been obtained from the London clay. A tooth, apparently of some species of this family, is imbedded in grey limestone from near Bath.

Amphibia.—Fossil bones of the Lamantin *(Manatus)* have been dug up on the sides of the river Layon, to the south of the Loire, in a calcareous bed formed of fossil shells. They were accompanied by other bones, belonging to *Phocæ* and *Cetacea.* Among these were fossil bones, determinately belonging to a *Manatus,* but different from any known species. Some of these bones were the bones of a seal, twice and a half as large as those of the common seal, *P. vitulina.*

No decided remains of the *Trichecus rosmarus,* or

Walruss, have been found; though several fossils have been supposed to belong to this animal.

Sauri [*].—We have been taught by the instructive labours of Cuvier, to whom science is so much indebted, not only the external characters which distinguish the several subgenera and species of existing crocodiles, but also those characters observable in the skeleton, by which the kind and degrees of accordance between the existing and fossil animals of this genus may be ascertained; and which also serve as points of comparison between the genus crocodile and those fossil saurian remains which demand to be placed under other genera.

Crocodile.—A saurian reptile, characterised by conical teeth disposed in a single row; a broad tongue not extensible; a tail flattened on its sides; the hind feet palmated, or semipalmated; with scales, nearly square on the back, belly, and tail. Besides these more general and comprehensive characters, the following have also been found in every animal of the genus which has been yet examined, and may sometimes be traced in their fossil remains. The feet, with five toes before and four behind; only three of these on each foot armed with nails; hence, two before and one behind are without nails. The nostrils form a long narrow canal, terminating in the gullet. The vertebræ of the neck bear a species of false ribs, which, touching at their extremities, hinder the animal from turning its head entirely on one side. The sternum, extended beyond the ribs, gives rise also to a particular species of false ribs, which do not articulate with the vertebræ, but terminate in the aponeurotic expansion.

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[*] *σαυροσ*, a lizard.

The genus is divided into the following subgenera:—

1. *Alligators.*—The head oblong, its length being to its width, at the articulation of the jaws, as 3 to 2; the length of the skull being more than a fourth of that of the whole head; the muzzle wide; the teeth unequal in size; and, at the least, nineteen, and sometimes twenty-two in number, below, on each side; and, at least, nineteen, and often twenty above. The first of the lower pierce, at a certain age, the upper jaw, and the fourth, which are the longest, are received into holes in the upper jaw, in which they are hidden when the jaw is shut. The toes are connected in only half their length by a short membrane. The holes in the skull, behind the eyes, in the species in which they exist, are very small.

2. *Crocodiles* (generally so called).—The head oblong, its length double its width; the skull being less than a quarter of the length of the whole head. The teeth unequal, fifteen on each side below, and nineteen above; the fourth tooth of the lower jaw, being the longest on each side, passes through a groove on each side of the upper jaw. The skull has two large oval holes behind the eyes. The hind feet are palmated.

3. *Gavials.*—The skull hardly a fifth of the length of the whole head; the jaws narrow, elongated, nearly cylindrical, and a little enlarged at the end. The teeth nearly of a size, from twenty-five to twenty-seven on each side below, and twenty-seven or twenty-eight above; the two first and the two fourth of the lower jaw pass through grooves on the outsides of the upper jaw.

The student, it is presumed, will be aided in his enquiries respecting the fossil remains of the Saurian animals in general, by reference to the following memoranda of the most prominent peculiarities observable in the skeleton of the crocodile, as instanced by Cuvier in the *Crocodile à losange*: observing, that the sutures and the number of the bones of the head are the same in every species, although their figures may be changed in consequence of the difference in the form of the head itself.

The most anterior of the bones of the head are the *intermaxillary bones*, which hold the fore-teeth. At the junction of these bones is the opening of the nostrils in their upper part, and in their lower part are the incisory holes. The *maxillary bones* are immediately behind these, each extending in a long apophysis which holds the last teeth, and is inserted between the *jugal bone* and *an unnamed bone* situated in the sides of the palate. The anterior parts of the *palate bones* are received between the maxillary bones; and the posterior parts, having widened a little, are applied to the anterior part of the internal pterygoidal apophyses which here form the lower part of the nasal canal, and, becoming extended, form a wide horizontal and triangular plate, at the posterior border of which the nasal canal opens. The unnamed bones on each side, already alluded to, join the lateral margins of this surface, and are united obliquely to the dental apophyses of the maxillary bone, leaving in the roof of the mouth, on each side, a large oval opening, surrounded by the bone already mentioned, which is considered by Cuvier as the external pterygoidal apophysis, by the maxillary, the *parietal bones*, and the plates of the internal pterygoidal apophysis.

The jugal bone joins, anteriorly, the posterior apophysis of the maxillary bone, passes under the orbit, and terminates behind in a point which forms the outer margin of the condyloidal apophysis or prominence of the skull.

The space which is commonly filled by one or two *frontal bones* is, in this genus, occupied by *five* distinct bones: a middle one, between the eyes, which articulates with the hinder part of the nasal bones, and is notched at its sides by the orbits, and forwarder by two other bones, supposed, by Geoffroy, to belong to the ethmoidal bone, and which form, by vertical apophyses, part of the orbital margin; the two other bones, decidedly parts of the frontal, yield apophyses which correspond to the post-orbital apophyses of the frontal bone, and, with that of the jugal bone, fill up the back part of the orbital frame, as in the ruminants.

The lower jaw is formed by six bones. The *dental*, in which are the sockets of the teeth: these bones unite in front, and form the anterior angle of the jaw. The *opercular*, which covers all the inner surface of the jaw, excepting at the fore part, which is formed by the dental alone. The *coronoidal* and *angular*, the former the uppermost, receive in their fore part the end of the dental, leaving between them a large oval opening. The angular bone turns upwards so as to fill a space on the inner surface of the jaw. Between this and the opercular bone is another oval, but smaller opening; and, beneath that, a considerable vacuity, as the coronoidal does not turn over on to the inside: the anterior point of this vacancy is bordered by a small *crescent-formed bone*. The condyle is formed by one particular bone, named the *articular bone*. The coronoidal has not, in the crocodile, any apophysis, as is the case in other reptiles.

The teeth are of the same number at all ages, and are never solid in the centre. They are pointed and enamelled; their surface is striated longitudinally, and they have a cutting edge on the fore and back part. It appears that they are frequently shed, since they are never found much worn, in very old, or even in fossil animals. The renewal of the teeth appears to be effected in this manner: the germ, at the bottom of the socket, gradually enlarging on the inside of the existing tooth, occasions in it a depression, and then, penetrating and splitting its substance, causes it to be shed. The first and the fourth teeth below, and the third above, are the longest and thickest; and then, in the crocodiles and the alligators, the eleventh below, and the eighth and ninth above, are the next in size. In the gavials, the rest after the fourth are nearly of the same size. The fourth tooth below, it is observed by Cuvier, may bear the name of the canine-tooth, as it answers to the suture of the intermaxillary and maxillary bones of the upper jaw. The five or six last teeth of each side are more obtuse and more compressed than the others, and the crown is distinguished from the tooth by an evident contraction; this, however, takes place only in the crocodiles and alligators; it is not observable in the gavials.

The *vertebræ* are sixty: seven cervicals, twelve dorsals, five lumbar, two sacral, and thirty-four caudals. All the vertebræ have the anterior surfaces concave and the posterior convex, and both circular: and the annular part is joined to the body by a suture peculiar to this genus and to the tortoise.

The *atlas* is formed of six pieces, which are distinct, being united only by cartilage. The *axis* is formed of five pieces. The annular part is joined to the body of the vertebræ by suture; and the odontoidal apophysis is united to the anterior surface by a cartilage.

From the other *cervical* vertebræ proceed those little false ribs or processes, which, by their pressure against each other, restrain the motion of the neck. The articular apophyses, although disposed in a position oblique to the horizon, are parallel with the axis of the spine: the spinous apophyses are high, narrow, and slightly inclined backwards; and beneath is a small spinous process bent a little forwards.

The first of the *dorsal* vertebræ has its spinous apophysis inclined as in those of the cervical; the inferior spinous apophyses are continued only in the five or six first. The four first have only one costal *facette* on the body, and one on their transverse apophyses; the six following have two on their transverse apophyses; and the two last have none.

The *lumbar* vertebræ differ from the dorsals in not having any of these *facettes;* and the spinous apophyses, as in the dorsal, are straight, wide, and square.

The two *sacral* vertebræ are distinguished by their strong, prismatic, transverse apophyses, for the support of the iliac bones.

The vertebræ of the tail resemble those of the loins, except in their bodies becoming more and more thin and compressed; their transverse apophyses diminish to the fifteenth or sixteenth, and then cease; their spinous apophyses become narrower and longer to the twenty-second or twenty-third, and then again diminish, and in the latter ones disappear entirely. Each vertebra from the second has beneath, at its posterior edge, two *facettes* to carry a branched chevron-formed bone, like an inferior spinous apophysis.

The ribs are twelve on each side, not reckoning the appendices of the cervical vertebræ. The two first and the last are not joined by a cartilage to the sternum. Under the belly are five pair of cartilages without ribs, which are attached to the aponeurosis of the muscles, the two last being fixed to the sides of the pubis.

The scapula is very small for the size of the animal. Its flat part forms a narrow isosceles triangle, and has no spine: its neck becomes cylindrical, then turns inwards, becomes spread, and presents a long surface to the clavicle; at the external part, forwards, is an apophysis, which, with a corresponding apophysis of the clavicle, forms the pit in which the head of the humerus is received.

The clavicle agrees very closely in its form, both in its head and body, with the scapula; the edge of its flat part being united to the sternum.

The humerus is curved in two directions; the upper part is convex forwards, the inferior concave.

The cubitus has no olecranon nor sygmoid surface; the upper extremity articulates with the external condyle of the humerus by an oval pit, widest on the radial side; its body is rather compressed transversely, and curved outwardly. Its lower end is the smallest, is compressed transversely, and is wider and descends a little lower on the radial side.

The radius is nearly cylindrical, and thinner and shorter than the cubitus. Its upper extremity is oval, the lower oblong, thinner towards the cubitus.

There are but four carpal bones; a carpal and a cubital, the first of double the size of the other, and both contracted in the middle; a third, which may be considered as a pisiform bone; and a fourth, lenticularly formed, placed between the cubital carpal bone and the metacarpal of the index and middle finger.

The metacarpal bones have a general resemblance to those of quadrupeds.

The thumb has two phalanges, the index three, the middle and the next four, and the little finger three. These two last having no nail, the terminating phalanx is very small.

The bone of the ilium is placed vertically: it is concave outwardly, and convex inwards.

The ischium is nearly in the form of the clavicle. It is united to its fellow by a flat part in the form of an isosceles triangle; its neck is thick, and its head is still more so. It has two facettes; one rough, which joins the ilium, and a smooth one which contributes to form the cotyloidal cavity. From the neck there passes forwards, and a little outwards, a flat apophysis which supports the pubis.

The pubis is a flat bone forming an isosceles triangle, supported by a cylindrical pedicle, which articulates with the apophysis of the neck of the ischium. The bones of the pubis do not touch, but are carried obliquely forwards and rather inwards, and are supported by the same aponeurosis which retains the false abdominal ribs.

The femur is a little longer than the humerus, and is curved in a contrary way. Its head is compressed in nearly a horizontal direction. Its only trochanter is a bluntish projection at about a quarter of its length from the top. Its lower extremity is widest in its transverse direction, and divides behind into two distinct condyles.

The tibia differs less than the cubitus does from the general form in quadrupeds. The fibula is thin and cylindrical; the head is very compressed; the lower extremity rather triangular.

The calcaneum does not differ from those of other quadrupeds, as do the other bones of the extremities. The astragalus is of a very different figure from that which it in general possesses. It has four surfaces: an upper one, small and square, to receive the fibula; an inner one, oblique and elongated, for the tibia; an external one, in the form of a crescent, which bears against the fibularian prominence of the calcaneum. All the lower part is occupied by an irregular tumid surface, the posterior part of which rests on the astragalian apophysis of the calcaneum, and the remainder supports the two first metatarsals. There are three other bones which may be reckoned among the tarsal bones.

The metatarsals are not particularly remarkable: they are larger and more equal than the metacarpal.

The number of the phalanges are, beginning with the great toe, two, three, four, four; the little toe has no nail.

It is necessary to observe, that the preceding sketch is referrible to all the species of crocodiles; even the head of the *Gavial*, the head which has so particular a form, has the same bones as the others, but, to render them conformable to the great lengthening of the muzzle, they exist in different proportions.

Cuvier notices a curious modification of the sphenoidal plates which form a vault over the palate bones, making, instead of a semicylindrical canal, a hollow of the size of a hen's egg, which communicates with the nasal canal only by a middling-sized opening. He has not seen it in the little *Gavial;* and from having seen this part more inflated in the old crocodiles from the Indies than in the young, he is not sure that it may not be, as in other sinus's, the result of age.

Fossil Crocodiles and other Saurian Animals[*].

ORDER. *Sauri.*

Division I.—Agreeing with recent genera, but specifically distinct.

Genus I.—*Crocodilus.*

The two species of Honfleur and Havre[†].

The *Crocodilus priscus* of Soemmering (*Munich Transactions*).

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[*] Having been favoured by the Rev. W. D. Conybeare with a systematic arrangement of the subjects of this section, and a compendious statement of their respective characters, I have introduced this valuable communication into the text; placing, in notes, such collateral matter as appeared to be required.

[†] The remains of crocodiles have been found in the neighbourhood of Honfleur and Havre, respecting which the celebrated Cuvier has ascertained the most interesting circumstances. These bones are stated to have

Species found in England:—One specimen was obtained from the Purbeck stone (now in the possession

been found in a bed of greyish blue calcareous marl, which, from the subsequent researches of M. de la Beche, appears to be the same with the blue clay occurring immediately beneath the green sand in the Weald of Kent, the Isle of Wight, &c. The under jaw is shown to be that of a crocodile by its shape; by the conical striated teeth, with cutting edges, placed in distinct sockets, and with a cavity receiving the replacing tooth. The sutures also show that the bones of the jaw are six in number on each side, nearly agreeing in their forms with those in the gavial; but in these jaws the branched part is longer than the anterior united part, and the angle made by the branches is not so open as in the gavials. The separation of the branches extends more among the teeth, there being in these jaws seven teeth in each branch; whilst, in those of the gavial, there are but two or three; and, at the same time, the whole number is less in the fossil than in the recent gavial, there being in the fossil but twenty-two on each side, whilst in the gavial there are twenty-five. Nor is the oval hole to be seen in the outer side of the branch, as in the lower jaw of the gavial. In these jaws the anterior end finishes in a point, instead of spreading out as in the gavial. The jaw, too, is less depressed and more cylindrical than in the gavial; but, in one specimen, a greater approximation to the snout of the gavial, especially as to its flatness, was observable, from which the existence here of two fossil species was suspected.

This supposition appears to have been confirmed by the examination of the accompanying vertebræ. The genus to which these belonged was determined by the body and the angular part being joined by a suture, which occurs only in crocodiles and tortoises, whilst several other characters decidedly show that they belonged to two different and to two unknown species.

In one specimen, containing the atlas and axis, a particular species was evinced by the tubercle of the axis appearing to be adapted for the articulation of two heads of a false rib, as in the succeeding cervicals; whilst in the existing crocodile there is but one. Another character, still more striking, is observable here, and in the succeeding vertebræ; the posterior surface, which is convex in all known crocodiles, is here concave; the anterior surface of the succeeding vertebræ being of a convexity adapted to the posterior concavity of the axis. This concavity, however, appears to diminish in some of the succeeding vertebræ, and, in some, the two surfaces appear to have been similar, nearly flat.

The transverse apophysis arises by four ridges which form for it a pyramidal base; and in the place of a single inferior spinous apophysis, as in of Mr. Johnson of Bristol), and another was found in Oxfordshire, at Gibraltar, on the Cherwell, in cornbrash (now in the Oxford Museum).

These are clearly distinct from Cuvier's first species, but may perhaps agree with his second. Vertebræ, apparently of that species, are found between the Kimmeridge clay and coral rag, near Weymouth. Crocodilian vertebræ are also mentioned as existing in the Sussex chalk, and vertebræ of the same species with those of Honfleur are found in clay between the green sand and the iron sand of that county *.

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known crocodiles, two ridges exist here, each terminated by a tubercle. The bodies of this series of vertebræ are more contracted in their middle than they are in the known crocodiles.

But in the same bed, and often mixed with these, are found the vertebræ of the other unknown crocodile alluded to. These vertebræ are not contracted in the middle; their transverse apophyses are not formed by the union of projecting ridges; and the chief circumstance in which they differ from the fossil species already mentioned, and from the recent crocodile, is, that neither anterior nor posterior surface of their bodies is convex, but both of them slightly concave. The sutures, and the disposition of the apophyses, are, at the same time, such as generically distinguish crocodiles.

* It was with peculiar satisfaction, that, whilst this part of the work was in the printer's hands, I was favoured by William Rhodes, Esq., with some fossil bones which had been found in a pit dug in the London clay, at the depth of eighteen feet from the surface, in Hackney Fields. Finding these to be the remains of a crocodile, and being aware that no such remains had hitherto been found in this formation, I immediately repaired to the pit, with the hope of securing the remaining parts of the skeleton; but too late: all the other fragments were irrecoverably lost, except a few broken vertebræ. On perceiving the skeleton, which, I was informed, was lying in a curved position, the workmen rushed on it with their pick-axes and shovels, each striving to obtain a portion of the supposed monster, until its demolition was accomplished.

The pieces which I obtained were two small fragments of the upper, and one of the lower, jaw, with a series of the vertebræ, and two obscure fragments of the leg.

Fortunately, the two pieces of the upper jaw, on being placed together, It is uncertain whether the remains from Whitby (lias), described in the Philosophical Transactions, are really crocodilian *. The remains described by Stakeley, in the Philosophical Transactions, and which were

gave the formation of the snout, from the ninth tooth to its anterior termination, and yielded a complete view of the grooves for the lateral admission of the large fourth tooth on each side of the lower jaw. The teeth were broken off to the margin of their alveoli: but they thus showed, in their transverse section, their cutting ridges, their striated surfaces, and their central cavity, beautifully encrusted with bright pyrites. The fragment of the lower jaw also was of its anterior termination, but of only half the length of the two fragments of the upper jaw, and contained four teeth on the left and two on the right side.

The form of the two conjoined pieces of the upper jaw, gradually tapering anteriorly, but enlarging at the termination, with the lateral grooves for the fourth tooth on each side of the lower jaw, proved decidedly that it was not the jaw of a gavial, or of the same species with the one whose jaw was discovered at Honfleur. The characters possessed by the jaw are those of the recent species, *Crocodile a museau aigu.*

The fragments of the vertebræ, though slightly mutilated, furnish useful and interesting information. Unlike the vertebræ of the two fossil species of Honfleur, as described by Cuvier, they have, throughout the whole spinal column, the anterior surface concave, and the posterior convex, and so strongly so, as fully to equal, if not exceed, those of the recent species in this respect.

I could procure only twelve vertebræ: of these, two were cervical; one, anterior dorsal; seven, posterior dorsal and lumbar; and two, probably anterior caudal; but the marks for the articulation of the chevron-bone were not visible. They corresponded so very nearly with the vertebræ of the recent crocodile in every particular, as to require no farther description than that which is given by Cuvier of these; his figures would also equally serve to represent them, for they differ only in having the extremities of their spinous and transverse processes generally broken off.

Of the uncertain fragments, one bears somewhat of the curved outline of the humerus, but, of the other, no opinion can be safely proposed.

It does not appear, from what is at present known respecting this fossil animal, that it specifically differs from the recent crocodile.

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* "The bones (Mr. Conybeare says) which I have seen from Whitby, are of the *Ichthyosaurus* and *Plesiosaurus*; I have seen no other."

supposed by Cuvier, from the incorrectness of the plate, to belong to crocodile, are decidedly remains of *Plesiosaurus*; nor have any crocodilian remains been found in the lias of the south-western countries. The crocodile said to have been found in the Derbyshire mountain lime, is asserted to have been a distorted *Orthoceratite*.

Genus II.—*Monitor*.

Some species of this genus are found in Thuringia *.

Division II.—*Enalio sauri* †, comprising genera differing from the recent, and fitted to live entirely in the sea.

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* In the cuprous and bituminous schists of several parts of Thuringia are found numerous impressions of fishes, and of other animals which had been supposed to be the remains of crocodiles and of some species of apes. This schist, which at Mansfeldt, Eisleben, and Ilmenau, is so celebrated for the beautifully pyritical impressions, rests upon a red sandstone, which, in many parts, contains coal, and has over it beds of limestone containing belemnites, terebratulæ, entrochi, and the remains of other animals of very early creation, and of marine origin.

The remains of fishes, thus found, have been considered as belonging to fresh-water fish; and Cuvier observes, that the observations made by him respecting the supposed crocodilian remains of this schist, must serve to confirm this opinion, he having ascertained them to belong to some of the numerous species of animals, comprised by Linnæus under the term of *Lacerta monitor;* and of *Tupinambis*, by Daudin: animals which frequent marshes and the shallow beds of rivers. Thus, as our justly celebrated teacher instructs us, we have here fresh proofs of fresh-water animals being covered by immense masses of the most ancient marine productions, and showing that the sea has repeatedly covered our continents.

The fossil remains which have been thus given to their proper animals, are—1st, the supposed *Crocodile* of Spence; 2d, the supposed *Crocodile* of Link; 3d, the *Sapajou* of Swedenbourg; 4th, a skeleton in the Royal Museum of Berlin. The supposed skeleton of a crocodile in the Cabinet of Dresden is supposed also to belong to the *Monitors*.

† εναλιος, marine, and Σαυρος, a lizard.

*Ichthyosaurus**.—A marine, oviparous animal; closely agreeing in the whole osteology of the head and sternum with the saurian tribe, except that the bones are usually, as in fish, united by squamous sutures; and approximating to fish in some parts of the structure of its vertebral column, and, in others, being *sui generis*. The four extremities are decidedly *sui generis*, and may be, in some respects, considered as forming a link between feet and fins: these are called paddles.

The following are the most essential particulars respecting its structure:—Dentition. The teeth are not lodged in separate alveoli, as in mammalia and crocodiles, nor do they adhere by a bony union to the inner side of the maxilla, as in other saurians, but lie loosely, retained only by the fibrous substance of the gum in a continuous furrow formed along the maxillæ; this furrow being only slightly contracted between the teeth. The secondary teeth, which replace the first set, are not formed in separate alveoli in the maxilla, but close on the inner side of the roots of the first, which are deeply excavated to receive them; thus they penetrate into and grow up within the interior of the old teeth, which they finally push or rather lift out. All the appearances in these stages of growth are absolutely conformable to those exhibited in the teeth of the crocodile, excepting that, in the crocodile, the old tooth, from the size of the conical alveolus containing it, does not admit of being pushed out without being previously split. But after these stages a difference takes place, for, in the crocodile, the teeth always remain hollow, a very frequent and reiterated succession of new teeth taking place; whereas, in the *Ichthyosaurus*, as in *Monitors* and other *Lacertæ*, their succession being less frequent, the hollow becomes filled in age by the ossification of the pulpy matter. This is the only point in which the dentition of these animals agrees. The bones of the lower jaw nearly resemble those of the crocodile, excepting that the temporal muscle, rather than the masseter, appears to have been employed in raising it, whereas in most species of crocodile the former muscle is a mere rudiment: hence the coronoid process is more developed, and the great oval hole, so characteristic of the crocodile's lower jaw, and probably serving for attachment to the masseter, is reduced to a long deep sinus. In these respects the *Ichthyosaurus* resembles the *Monitor* and other lacertians, but differs in the general contour of all this part and of its constituent bones, especially in the almost entire concealment of the articular bone within it, which, in these, forms all

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* Naturalists are under great obligations to Sir Edward Home and Professor Buckland for their long continued perseverance in the investigations respecting the nature of this fossil animal.

At the desire of Mr. Conybeare I state, that, in drawing up the following notice, which includes an outline of the progress made in developing the structure and relations of this animal since his communication to the Geological Society, he wishes to acknowledge his obligations to the same friend to whom he has alluded in the published memoir, as inclined to refer the *Ichthyosaurus* rather to the lacertian division of the *Sauri* than to the crocodilian type. It has been his own endeavour to expose, as fairly as possible, its relations with both.

The account above given of its dentition is now confirmed by a suite of decisive specimens of teeth, both in, and detached from, the jaw, containing every stage of the process. It will at once be seen, that it differs most essentially from that of the *Monitor*, &c. in whose teeth a large bony secretion, supplying the place of the root, unites them to the maxilla, with which this osseous mass is organically incorporated: the new teeth, formed in distinct alveoli, pierce laterally, or transversely, across this osseous mass.

In the *Ichthyosaurus* there is no similar osseous union, but the base of the tooth, which lies quite freely in its place, is a simple prolongation of the conical body of the tooth, exactly as in the crocodile. The dentition is a point so important, that it has been necessary to dwell upon it more at length. The illustration of these points will form the subject of a memoir shortly to be laid before the Geological Society.

the external and posterior part; the *Ichthyosaurus* agrees in these points with the crocodile.

In the head the position of the nostrils is peculiar, being behind the snout, and close in front of the orbits; but the posterior opening of the nasal canal into the throat is placed far back, behind the internal pterygoid processes, which, as in the crocodile, form a continuous plate beneath it; consequently the whole structure of the roof of the mouth assumes an arrangement completely agreeing with the crocodile, and entirely distinct from that of the other lacertians. The bones surrounding the orbit are not very distinctive, but agree rather with the crocodile than with other lacertæ; the sclerotica, however, resembles that of the latter class, by its division into scales.

The cavities behind the orbits, compared in the Geological Transactions to those similarly placed in the crocodile, bear, in their extent, a greater analogy to the temporal fossæ of other lacertæ, since the temporal muscle which is attached near their edges, being in both the *Ichthyosaurus* and lacertians the principal mover of the lower jaw, requires greater space, whereas, in the crocodile, it is scarcely called into play, except in the *gavial*, where these fossæ necessarily have their dimensions much enlarged. These post-orbital fossæ of the crocodiles, however, may be considered as the true analogues of the temporal fossæ in the other lacertæ, serving the same purposes and surrounded by the same bones, so that the difference in this respect is not material; it arises only from the greater employment of the temporal muscle, and cannot be compared with the differences, in the same respect, between different species of the crocodile, for instance between the *Caiman a paupiéres osseuses* and the *Gavial.*

The most striking difference, perhaps, in the whole osteology of the head of crocodiles, and other lacertæ, is in the posterior parts of the head; the position and mode of connection of that division of the temporal bone which articulates with the lower jaw, and the place of the *meatus auditorius*. In these respects, the *Ichthyosaurus* approaches nearly to the crocodile, and recedes entirely from the other lacertæ.

The vertebræ agree with neither class of *Saurians*, but, by their deeply hollowed and double concave form, approximate to those of fishes, closely resembling those of the shark in their proportions: in order further to facilitate motion in every direction, the annular part has a distinct articulation with the body; a provision peculiar to this animal.

The humero-sternal parts consist like those of the lacertæ generally, and of most oviparous animals, except fishes, of the furcula or clavicular arch *, the scapulæ, two bones representing the coracoid processes, and humeri. These last support the paddle, consisting of many series of small polygonal bones, very greatly surpassing, in number, the phalanges of quadrupeds, or even the analogous bones in the fins of fish.

Species I. *I. communis.*—The apex of the teeth forms a cone less acutely pointed than in the following species. The head, figured in the Philosophical Transactions for 1819, *Pl.* III, belongs to it.

Sp. II. *I. tenuirostris*—The apex of the teeth is more elongated and more acute. The head, figured in the Philosophical Transactions for 1820, *Pl.* XV, belongs to it.

Sp. III. *I. platyodon.*—The teeth are more flat and smooth than in the former species. It is not yet figured.

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* The crocodile is destitute, however, of the clavicular part.

All these species, in which the teeth form the most obvious distinguishing mark, are found in the lias; one other species, at least, is found in the Kimmeridge clay, and is sufficiently characterised by the contour of the cervical vertebræ, but the difference would not admit of description in an elementary work. The remains of the *Ichthyosaurus* are also found in the calcareous grit under the coral rag, and in clay above the iron sand; so that it may be considered as common to all the beds between the red marl and green sand, or perhaps chalk.

Plesiosaurus *. — Mr. Conybeare observes, he has nothing to add here to the generic description given in the paper in the Geological Transactions, except that the dentition appears to have been as in crocodiles, and the teeth to be placed in alveoli †.

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* πλησιος, approximate to, and Σαυρος, a lizard.

† To render the present account more perfect, it has been thought proper to introduce, from the paper of Messrs. de la Beche and Conybeare, the following abridged account of their observations:—

The newly-discovered animal adds another to that family, which, approaching closely to the lizard family, and especially to the genus *Crocodile*, differs from it in many important characters, especially in the structure of their paddles, which possess an intermediate structure between the feet of quadrupeds and the fins of fishes, and approaches, in many respects, most nearly to the paddles of turtles.

This animal appears to be intermediate between the *Crocodile* and *Ichthyosaurus;* but whilst the *Ichthyosaurus* recedes from the forms of the lizard family, and approaches those of fishes, the new animal approximates, in these respects, more nearly to the *Crocodile:* they therefore describe *Plesiosaurus* as a marine animal, intermediate in its structure between the *Ichthyosaurus* and *Crocodile.*

The teeth have not been decidedly ascertained: a peculiar tooth, however, not belonging to any species of *Ichthyosaurus,* yet evidently of the crocodilian type, occurs in the lias, and may, with great probability, be referred to this animal.

I am happy in having been favoured by Mr. Conybeare, since the pub-

Species I. *Pl. priscus.*—The cervical vertebræ in this species are the thickest in the series. All the bones of this genus, figured in the Geological Transactions, beleng to this species. It occurs in lias.

lication of his paper, with the following account of the head of this animal, which has been lately found:—

"Of the head of this animal only a single specimen approaching to completeness has yet occurred. It was discovered by Mr. Thomas Clarke, in the lias of Street, near Glastonbury: unfortunately, it is much crushed, but is yet sufficiently perfect to exhibit its most essential osteological characters.

"These characters when viewed collectively, present, as might have been expected, an assemblage *sui generis;* taken separately, they exhibit partial approximations to the *Ichthyosaurus*, the *Crocodile*, and the *Lacertian* family (more strictly so called, as considered exclusively of the crocodilian branch), nor is there any structure which may not be paralleled from one of these three types: on the whole, we should be inclined to pronounce (though not without hesitation) the approximations to the latter class to be most close and important.

"Its general contour, the character of its temporal fossæ, and the position of its ossa quadrata, resemble the *Lacerta*, *Iguana*, &c.; but the small size of the nostrils, the conformation of the palatal and pterygoidal parts of the roof of the mouth (as far as the specimen enables us to judge of them), and the dentition, remove it from this type.

"It agrees with the *Ichthyosaurus* in the position and small size of the nostrils, and in the structure of the palatal and pterygoidal parts (in which both animals approximate to the crocodilian type); but it differs in the comparative shortness of its snout, which gives an entirely dissimilar character to its whole contour, in carrying its teeth in distinct alveoli instead of a continuous furrow, and in all these points which we have mentioned, as peculiarly resembling the proper lacertian tribe.

"The only circumstances of peculiar analogy with the crocodile, are the dentition (as before stated) in distinct alveoli, and the distribution of the holes in the maxillary bones giving passage to the branches of the maxillary nerve. We have already mentioned the analogies which are common to itself and the *Ichthyosaurus*.

"Like the *Ichthyosaurus*, then, this animal seems, in a certain degree, to have blended the characters of the lacertian branch of *Saurians* (properly so called) with those of the crocodile, and to have been, in the same

Species II. ***Pl. recentior?***—**The cervical vertebræ in this species are the thinnest in the series, and scarcely thicker in their proportions than those of the *Ichthyosaurus*; while the dorsals are**

manner, distinguished from all recent *Saurians* by an inferior developement of the olfactory organs."

The vertebræ agree more nearly with the crocodile than with the *Ichthyosaurus*; their annular part is attached to the body by sutures, and there are transverse processes throughout the greater part of the dorsal vertebræ, which, together with the whole of the annular part, very nearly resemble the corresponding forms in the crocodilian type. They differ from them,

1. In place of being concave at one extremity and convex at the other, thus articulating by a species of ball and socket-joint, they are slightly concave at both extremities of their body, but again slightly swelling in a contrasted curve near the middle of the circular area. In these features, however, Mr. Conybeare observes, they agree with one species, at least, of those found in a fossil state in England, France, and Germany, and all the fossil species appear to have this structure in the posterior part of the column.

2. They differ from both the fossil and recent crocodiles in much narrower proportions; though far less so than do those of the *Ichthyosaurus*.

3. The number of cervical and dorsal vertebræ in this animal appears to be forty-six; a number almost double that of any recent saurian animal, and greater than even that of the *Ichthyosaurus*, which does not seem to possess above forty-one.

4. They farther differ from both recent and fossil crocodiles, in having the ribs through the greater part of the dorsal series articulated only to the end of the transverse processes; at least, twenty-eight appear to be thus circumstanced, whereas this takes place in the three last of the crocodile only; in the other saurian animals, however, all the ribs are thus borne.

Colonel Birch's specimen exhibits a series of sixty-three vertebræ, but several appear to be missing, and it comprises only the first twelve of the tail: there are as yet no means of surmising even the number of caudal vertebræ. M. de la Beche has a continuous chain of eighteen middle dorsal; and, in the late Mr. Calcott's collection, there is another continuous series of nine, the eighth of which carries the last short rib; this specimen seems fortunately to have succeeded almost immediately to the former. The cervical and first dorsal vertebræ appear to have possessed similar forms. They have no transverse processes; the line of suture with the annular part is angular, and they have on either side of the body a double notch, into which appears to have been inserted, by a double stem, of the same proportions as the former species. The annular part of the vertebræ is also permanently distinct from their body, articulating in a regular socket, as in the *Ichthyosaurus;*

a tubercular process corresponding to the inferior tubercle in the cervical and anterior dorsal vertebræ of crocodiles, and, like it, bearing the false ribs which protected the neck and the first true ribs.

The position of this double notch is near the bottom of the side in the first vertebra, and gradually ascends till it almost rises to and runs into the annular suture in the twelfth. In the course of the succeeding four vertebræ, the upper of the two notches runs into and extends the margin of the annular suture; and, in the next (the eighteenth), the lower notch becomes a distinct tubercle; thus two articulating surfaces are afforded, one on the tubercle, and a second on the cavity formed by the prolongation of the lip of the suture, of which the former must receive the head, and the latter the tubercle of the anterior ribs. A similar structure exists in the cervical and anterior dorsal vertebræ of the *Ichthyosaurus;* and it corresponds also in some degree, at least, in the office of these parts, with the first dorsal vertebra of the crocodile, in which the transverse process is not yet fully developed, and remains only a tubercle. At length the lower tubercle also disappears, and is swallowed up in a still longer prolongation of the margin of the annular suture; at the same time, the stems by which the annular part was attached to the body expand their bases laterally, so as to form incipient transverse processes. All the vertebræ, from the first developement of the transverse processes (twenty-seven in number), carry the ribs on a single articulating surface at the end of that process, like the three last dorsals in the crocodile, and the whole series in most other saurians. The pointing upwards of the transverse processes in the middle of the series seems intended to give a wider sweep to the ribs flanking the thorax and the abdomen.

The lumbar and caudal vertebræ appear to differ in form from one another only in a less inflection of the lower margin, for the purpose shortly to be mentioned; they are, however, very distinct from all the others: they have no regular transverse processes, but, instead of them, two separate bones flattened at the extremities, and articulated into a socket near the upper part of the sides of the bodies of the vertebræ; their position is exactly horizontal. The *Ichthyosaurus* appears to have had similar bones. The lower margin of these vertebræ on the posterior extremity is inflected so as to form two regular indentations, exactly as in the crocodile, for the reception of the chevron-shaped bone beneath the tail. The middle dorsals are considerably larger than those of the extremities of the and not anchylosing in the adult animal, as in *Pl. priscus*: yet the general analogy of the bones, as far as hitherto ascertained, seems to warrant their being regarded as a distinct species. It has not yet been described.

column. There have been, as yet, no means of even surmising the number of caudal vertebræ.

It appears, then, that the vertebral column of the *Plesiosaurus* recedes from that of the *Ichthyosaurus* in all the points in which the latter approaches to the fishy structure; that the intervertebral substance must have been disposed much as in the *Cetacea*, and that on this account, as well as because the annular parts were firmly attached to the bodies, and, therefore, by the locking into one another of their articulating processes, must have given a considerable degree of stability to the column, it must have possessed, in a much less perfect manner, the flexibility which facilitates the peculiar motion of the *Ichthyosaurus* and of fishes. But this was much less necessary to these animals, inasmuch as the structure of their extremities rendered them much more powerful instruments of progression.

Mr. Conybeare states, that he has never seen the bone which he had called, in the *Ichthyosaurus*, the furcula or sternal arch, which he thinks it is most probable, from the form of the scapula, must have existed in this animal also.

The bones of the anterior extremity, the flat clavicles similar to those of the *Ichthyosaurus*, the scapula and humerus, were found, though loose and detached. Two bones were also found to which were assigned the office of radius and ulna, their articulating surfaces agreeing at one end with those of the humerus, and, at the other, with those of the paddle.

The three first paddle or carpal bones have a general resemblance to the phalanges of reptiles, but are more flattened. The series of small bones forming the paddle was very numerous, approaching, in this respect, to the structure of the analogous part in the *Ichthyosaurus*, with a series of round bones like those which form the external bones of the Ichthyosaurian paddle.

Thus, therefore, Mr. Conybeare observes, a general similiarity of organisation between this important member in the *Plesiosaurus* and *Ichthyosaurus* appears to be established; whilst, on the other hand, a comparison with the paddles of the sea-turtle will exhibit such fresh analogies as to indicate that, in respect of the various forms of the animal extremities, the *Plesiosaurus* holds, as it were, a middle place between it and the *Ichthyosaurus*.

Its geological habitat is the Kimmeridge clay near Weymouth, and in the Headington quarries near Oxford.

Megalosaurus[*].

An animal, apparently approaching the *Monitor* in its mode of dentition, &c., not yet described. It is found in the calcareous slate of Stonesfield, subordinate to the upper part of the lower or great oolitic series, including the forest marble, &c. Drawings have been made of the most essential parts of the animal, now in the Museum at Oxford; and it is hoped a description may shortly be given to the public. The animal must, in some instances, have attained the length of forty feet, and stood eight feet high.

Mosasaurus.—The saurus of the Meuse, the Maestricht animal of Cuvier.

As Cuvier has not yet given it a name, this name is suggested by Mr. Conybeare until he has done so.

Species I. Described by Cuvier.

II. *Lacerta gigantea* of Soëmering.

This animal is considered, by Cuvier and A. Camper, as *sui generis;* its head placing it irrevocably between the *Monitors* and the *Iguanas.* But, as is observed by Cuvier, how enormous is its size compared with all known *Iguanas* and *Monitors.* None of these have a head longer than five inches; and that of this fossil animal approaches to four feet.

Its mode of dentition distinguishes it from the crocodile. Its teeth have a central hollow, only whilst growing; this at length fills up, and they generally become entirely solid, being fixed to the jaw by means of an osseous and fibrous body, which, although they are intimately united with it, is very different from the proper substance of the teeth. The replacing tooth grows in its particular alveolus, which is formed at the same time; and, at length, it pierces the osseous body bearing the former tooth, at its side or across its substance; and, as it grows, it detaches this body by interrupting its organic connection with the jaw, and occasions it to fall, like the horn of the stag, by a species of necrosis, the old tooth falling with it: the new tooth, with its osseous body, improperly called its bony root, takes the place the old tooth has left.

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[*] μεγαλοσ, great, and Σαυρος, a lizard.

In the lower jaw are fourteen teeth, nearly regular in size, and about ten or twelve foramina, or rather holes, for the passage of vessels, &c. The coronoid apophysis is raised, obtuse, and wide in its anterior margin, as in the *Monitors*. In these, and other points, the jaws agree more with that of the *Monitor* than with any other saurian. But the palate bones, unlike those of the *Monitor*, were found to be armed with teeth, a character belonging to the *Iguanas*. These palatine teeth, eight in number, and necessarily small, appear to have grown, and to have been fixed, shed, and renewed, like those in the jaw itself.

All the teeth are pyramidal, a little bowed; their outer surface is flat, and distinguished by two sharp ridges from the inner surface, which is round, or rather semiconical.

The vertebræ, like those of the greater part of the saurians and ophidians, have their bodies concave forwards, and convex backwards. From the form of those, and particularly from the great size of the chevron bone, it appears that the tail was, like that of the crocodile, long and flattened on its sides, and that it acted sideways. A distinguishing character in this animal is, that the chevron-bones are not articulated with, but are united to, and form one body with the vertebra. The number of the vertebræ appears to be one hundred and twenty-eight. The length of the tail appears to have been ten feet; of the trunk, nine feet five inches; which, with three feet nine inches for the length of jaw, makes the whole length of the animal about twenty-three feet. The indefatigable Cuvier determines, from his researches, that this animal was of an intermediate genus between the tribe of saurians with an extensible forked tongue, like the *Monitors* and ordinary *Lizards*, and those with a short tongue and a palate armed with teeth, as in the *Iguanas, Anolis,* &c. Without doubt, he says, it will appear strange to some naturalists to see an animal surpassing so much, in its dimensions, the genera to which it approaches the nearest in the natural order, and to find its remains with marine productions, since no saurian is now known to live in salt water; but these singularities, he observes, are of very little consideration in comparison with so many others which offer themselves to our observation among the numerous monuments of the natural history of the ancient world.

The only fossil remains by which the presence of any saurian reptile could be determined in the Montmartre quarries, was a frontal bone of a crocodile of a small size.

Tortoise.—The *carapace*, or buckler, of these animals, is formed by the eight pair of ribs and the annular portions of the nine dorsal vertebræ, which spread so as to unite, by suture, into one piece. The *plastron*, or breast-plate, is a second buckler formed by the sternum, which in tortoises is composed, according to M. Geoffroy, of nine bones, commencing at nine points of ossification, but not always meeting so as to form a continuous surface.

The sea-tortoise (*Chelone,* Brongniart), which agrees with the soft tortoise (*Trionyx,* Geoffroy), as respects its breast-plate, resembles the common tortoise in another point; the whole circumference of the *carapace* is girt with bony pieces united to each other and to the ribs. These encircling pieces, which M. Geoffroy compares to the cartilaginous parts of ribs, are wanting in the soft tortoises, or, at least, always remain cartilaginous or membranous, so that the middle part only of the *carapace* is supported by a bony disk.

To distinguish the genus to which any of these coverings may belong, as Cuvier teaches, it is only necessary to combine, with the foregoing characters, such as are yielded by their forms. These are, in the land-tortoise, always oval and pointed forwards; in the sea-tortoise, elliptical and tumid; in the land-tortoise, elliptical; and more or less depressed in the fresh-water tortoise; with a rough and shagreened surface in the soft tortoises; and raised in different projections in the *chelydes* and the *serpentine.*

The feet also furnish distinguishing characters of the subgenera of these animals: thus, they are very long, with very unequal toes in the sea-tortoise; the toes are exceedingly short in the land-tortoise; moderately long, and rather equal, in the fresh-water tortoise and the *chelydes;* and, in the soft tortoises, it is to be observed, that three only of the toes bear talons; but the bones of the toes, in a fossil state, having lost their connecting medium, can only be judged of from their forms.

The head of the *chelydes* is known by its flatness, and by its transverse jaws; that of the sea-tortoise, by the temporal region being covered by a bony vault; and that of the soft tortoises, by the long and bowed fringe.

The ossification of the intervals between the ribs is performed slowly, and, proceeding from the middle part towards the edge, it is terminated generally later than that of the ribs themselves.

The fossil remains of these animals are, with difficulty, referrible to even the several genera into which they are divided.

It is only, of course, the hard parts of the animal which are preserved by petrifaction; hence the bones of the toes, losing their connecting medium, become detached, and it will only be by their forms that any conjecture can be made whether they were distinct, clubbed, or webbed. In all those species, too, of the genus *Emys,* in which the *carapace* was in a soft state, some ambiguity will arise, since it will not be always easy to determine whether the irregularity and apparent imperfection of form has depended on the original structure of this part, or has proceeded from violence. Thus, in the fossil remains of one of these animals, found in the neighbourhood of Melsbroeck, near Brussels, was determined, by Lacepede, to have belonged to *Testudo mydas,* Linn.; and Camper describes the back of a fossil tortoise which was four feet in length and only six inches in width; the preserved part in this, and similar specimens, being the hard and osseous part of the animal which extended along the vertebral column, the difficulty having arisen from the loss of the coriaceous or horny covering with which, in that species, the remaining part of the superior covering had been formed.

A fossil *carapace* from Melsbroeck, in the neighbourhood of Brussels, was supposed, by M. Faujas St. Fond, to belong to *Test. mydas;* but Cuvier observes, that, in the fossil specimen, the intervals of the ribs are completely ossified, there being no space between their ossification and the border, which is much wider than in its supposed analogue; and, on other considerations, he determines that it is of an unknown species. This acute anatomist has observed that M. Faujas St. Fond has erred in considering some fossil remains of tortoises, found in St. Peter's mountain, Maestricht, as possessing specific characters derived from their forms; since those forms have been produced, in one case, by their having lost a part, and, in the other, the whole of their bony margin: and he is satisfied that these fossils belong to sea-tortoises of unknown species.

In the mountain named Plattenberg, near Glaris, have been found the fossil remains of tortoises, and which are supposed, by Cuvier, to have been sea-tortoises, but respecting their species he cannot form any judgment. In the neighbourhood of Aix are found the remains and impressions of tortoises, which, from their vaulted forms, are considered as the remains of land-tortoises.

The fossil remains of tortoises do not appear to have been found in any formation older than that of the lias, unless that fossil should be excepted which Knorr states to have been found near Glaris, the matrix of which he describes as being a black schist.

Mr. Johnson, of Bristol, was rewarded, during a zealous and judicious search in the lias on the borders of the Severn, with some very interesting remains of tortoises. Their remains have also been found in the calcareous slate of the oolite formation at Stonesfield; but in no place have their remains been found much more perfect as in the London clay in the Island of Sheppey.

The soft tortoise (*Trionyx*, Geoffroy) appears to have furnished the fossil remains of this genus in the plaster quarries of Montmartre. It should be remembered, that the ribs in this subgenus do not have the spaces between their ribs ossified in their whole length; that their ribs do not articulate at their outer ends with the bony margin; and that their surface is always shagreened or grooved with an infinity of little irregular pits, by which the soft skin, the only tegument with which the *carapace*, in this subgenus, is covered, is rendered more adherent. The *trionyx* is not known to live in any other situation but in fresh water.

There appear, besides these, to be the remains of two species of fresh-water tortoises, *Emydes:* and no fossil remains of sea-tortoises have been discovered in these quarries.

In the neighbourhood of Verona, and chiefly in the valley of Ronca, a formation, bearing a close accordance with that of the London clay, the fossil remains of tortoises are also found, but in fragments too small to yield any characteristic marks of the species to which they belong.

Solipedes.— The *Horse:* The fossil teeth of horses have long been described by different authors; and have sometimes been attributed to giants, hippopotami, &c.; but, although they have been found in a state of petrifaction, and in the same caverns with the remains of tigers, rhinoceroses, and hyænas, and even in the same deposits with unknown animals, there are no anatomical differences discoverable in the skeletons of the fossil animals which will distinguish them from those which are found in alluvial deposits, or from those of horses which are now existing.

The remains of this animal are frequently found in peat beds, and in alluvial depositions. I do not know of any instance of their being found imbedded in a lapideous mass.

The ox, or the buffalo, are the animals with which the remains of the horse are most likely to be confounded; to prevent which, Cuvier has favoured us with the distinctive characters of the several bones of both animals. But, as the bones are, generally, exceedingly mutilated, it appears to be sufficient here to point out the differences between the teeth of these animals.

The teeth of the upper jaw of the horse are, like those of the ox and buffalo, of a prismatic form, with four double crescents, and with an additional one in the middle of the inner margin. The lower teeth are more compressed, they also have four crescents in the horse as in the ox; but, in the former, instead of being parallel, two and two, they are alternate, the first of the inner side corresponding with the interval between the two on the outer side.

Ruminantia or *Bisulca.*—The preserved remains of the different genera of this tribe of animals are, from the general agreement in their characters, very difficult to be distinguished. Horns, resembling those of the common stag, are very frequently found in beds of alluvial formation. But they are also found associated with the remains of elephants, rhinoceroses, and hippopotami, in beds of a greyish calcareous deposition in the upper parts of the London clay in Essex, and at Brentford in Middlesex.

Irish Elk.—The remains of this animal were formerly found only in the boggy soil of some parts of Ireland, and hence it has obtained its distinctive appellation. They have, however, within these few years, been found on the Rhone, near North Dreighton in Yorkshire, and, a few years ago, I found some of their remains at Walton in Essex. The magnitude of these horns may be presumed, from the distance between the extreme tip of each horn, which is ten feet ten inches. It is rendered certain, by a careful comparison, that this animal is at present unknown, and was materially different from the reindeer or elk of these times.

Horns have been found in Scania resembling those of the fallow deer, but one third larger. These are supposed, by Cuvier, to have belonged to some unknown animal.

In blocks of sandstone, in the neighbourhood of Etampes, are found small stag's-horns of a size between the stag and the roebuck; they are small, thin, and rather flat; and although the root is nearly round, the beam immediately becomes flat. These are not the horns of young animals, their epiphyses being found in union with their bones. There is no known animal to which these bones can be referred. Horns, resembling those of the roebuck, have been found among the remains of lost animals in the quarries of Montabusard.

Very large fossil heads of the ox kind have been found in different parts, respecting which it has been found difficult to determine, whether they were or not similar species with those which are now in existence.

M. Faujas was satisfied that the large fossil heads of the ox were of two distinct species. In the first species the cores were placed in a horizontal position, and measured, though the animal was young, more than twelve inches and a half in circumference, and the distance from one orbit to the other was more than thirteen inches. The distance from the upper extremity of the forehead to the edge of the occipital foramen was little more than four inches and a half; and on the forehead, between the commencement of the two horns, is a slight protuberance of an oval form. In the second species, the horns formed a kind of crescent inclining downwards; the circumference of the core of the horns, at their base, was thirteen inches; and from the upper edge of the forehead to the edge of the occipital foramen but four inches. The forehead, which was quite flat, is to be considered, at its upper extremity, as forming a line with a little convexity, rather than a protuberance. Cuvier considers that the horns of the first species, which Faujas attributed to a species of ox, belongs to the *Auroch;* but this he does not appear to have established. The second species is supposed, by Cuvier, to have belonged to that wild race from which our present domesticated oxen proceeded. Pallas supposes a fossil skull, found in Siberia, to have belonged to the common buffalo of India, or to a very large species named *Arnis;* but Cuvier believes it to have belonged to a species entirely different from the buffalo, the arnis, the ox, or the aurochs. Pallas also discovered a fossil skull of another species in Siberia, which he believed to belong to the musk-ox of Canada, an opinion in which Cuvier concurs.

It appears that the fossil ruminants belong to two orders of alluvial deposits, and consequently to two different geological epochs; the one having been buried in an age distant from the period in which we live, but the others at a far more distant period; in that revolution in which the elephants, rhinoceroses, mastodons, &c. inhabitants of the torrid zone, were destroyed.

It does not appear that the teeth of *boars* have been found but in modern alluvial depositions, and no ways differing from those of the recent animals.

Ossiferous Brecciæ.—In the rock of Gibraltar, at Concud near Arragon, in the northern part of Corsica, in Dalmatia, the islands of Cherso and Ossero; in several of the islets of the Adriatic, on the northern shores of the Mediterranean, and in many parts, several leagues distant from each other, the solid rocks appear to have been split in different directions, but chiefly perpendicularly, and their fissures to have been filled with fragments of calcareous rocks, and the bones of various animals, lying in all directions, and most of them broken: sometimes mingled with the shells of snails and pieces of calcareous spar of a darkish brown colour; and which having been long exposed to the action of water, have become enveloped and cemented together by stalagmitic depositions. Sometimes the spathose matter is colourless, and, at other times, of a yellowish and reddish brick colour. The concreted masses resemble each other in their colour and composition in most of the places in which they are found; except in the Vincentin and Veronese, and at Concud; where their cementing matter is of a much lighter colour. Some of these bones have been found at fifty-seven feet above high-water mark.

It was long believed that many of these bones were human: of this opinion, at one time, was Abbé Fortis, and even Mr. John Hunter; but it is now ascertained that they are not so, and that they belonged chiefly to quadrupeds. Cuvier believes all those which he examined to be the bones of ruminants, hardly the size of a deer; and from no horns or branches being found, and from appearances yielded by some of the bones, he is disposed to refer them to the antelope. This friend to science found, in the Breccia of Cette, the bones of the common wild rabbit; of another rabbit, one-third smaller; of a field-mouse; of a bird of the size of the common wagtail; and of the common adder. At Nice and Antibes, the remains of horses and of ruminating animals, of the calf and the stag, were found. In the Breccia of Corsica, bones belonging to *Rosores* only were found, resembling those of the rabbit, guinea-pig, or rat: an enormous quantity of the bones of the water-rat, and, perhaps, of the land-mouse (*Mus terrestris*, Linn.), was also found in this Breccia. The head of an animal of the genus *Lagomys*, Cuv., was also found here, but which did not agree in size or proportions with any known species. From the accounts which he collected, as well as from his own observation, Cuvier concludes, that the phenomena respecting these bones point them out as posterior to the last resting of the sea on our continents, since there are no sea shells mixed with them, and they are not covered by any other beds; that the bones, stones, and other matters, have fallen successively into the clefts, and that the stones have proceeded from the rock itself; that the bones are of herbivorous animals, and that the greatest number belong to known animals, and even to those which still exist in those parts; and that the formation of these brecciæ is modern, compared with the great strata of stone, and with the alluvial strata containing the bones of unknown animals; but is still ancient with respect to us, since some of them contain the bones of unknown animals. But the phenomenon which, in the opinion of Cuvier, is most interesting, is the facility with which these rocks appear to have been thus divided by clefts in which these substances have been deposited.

Pachydermata.—Elephant: Fossil remains of this genus have been found in many parts of Europe, and, indeed, in most parts of the known world. That the East-Indian and African elephants are specifically different is now well known. This is most obvious in the structure of the teeth: the plates of which the teeth are chiefly formed, are composed of the bony part of the tooth, surrounded by enamel, and held together by a connecting substance, the *crusta petrosa*. In the East-Indian elephant these plates, disposed across the tooth, are flat, and, all through, of an equal thickness, their sides being covered with numerous rough longitudinal striæ; but, in the African, the form of the lamellæ is different, being more lozenge-formed; an angular vertical projection on the middle of their sides, keeping these lamellæ at a greater distance from each other at their ends, and necessarily occasioning there to be fewer plates than in the Indian. These plates, in both species, terminate inferiorly in digitated or rather radical processes, which appear on the surface when the tooth is worn down low.

The teeth of the fossil elephants differ materially from those of either of the recent species: their plates, in one of the fossil species, are thinner, and, consequently, exist in greater number than in the recent teeth. In the recent teeth, even of the East-Indian species, there are seldom more than ten or twelve plates brought into use at once; but, in the fossil teeth, they are frequently from eighteen to twenty, and sometimes twenty-four, to be seen at the grinding surface. Cuvier observes two other distinctive characters; that the lines of enamel are thinner and less crenulated in the fossil than in the recent; and that the width of the fossil exceeds that of the recent in the proportion of eight to six. It is therefore established that, at least, one species of elephants existed in the former world, of which no analogous animal is known in a recent state. The grinding surface of the common fossil tooth is represented *Pl.* X, *fig.* 8.

Many, and some rather ludicrous, mistakes have been made respecting the fossil remains of elephants' teeth. One of the plates of a tooth was considered, by Kundman, as the petrified paw of a large baboon; the flesh, nails, and veins having been all supposed to be discoverable in it. The plates are connected by the unorganised *crusta petrosa,* which becoming disintegrated during the inhumation of the fossil, occasions the separation of the plates; the digitated processes of which, in this instance, gave rise to the mistake as to the existence of the fingers.

An attention to this circumstance will, it is believed, establish the existence of, at least, one more species of fossil elephants than had been noticed by Cuvier. The examination of the teeth of both the recent species and of the fossil species examined by Cuvier, shows that the dental plates are entirely detached from each other, so that, on the decomposition of the *crusta petrosa*, they separate; in which state they are frequently found. But in three different specimens which I possess, instead of the plates of enamel, enclosing the bony part, being carried straight across the tooth, they are continued in dædalean lines. One double deeply undulating line of enamel forming the sides of one wide and deeply indented compages of osseous matter; filling the space, which, in the teeth of the other species, would be occupied by four or five plates. *Pl.* X, *fig.* 9.

The specific difference in these teeth will evidently appear, when it is considered that the undulating forms of the plates must be accompanied by a very different arrangement of the bony substance and enamel with respect to the *crusta petrosa;* and entirely prevent the separation into flat plates, as in the teeth of the other fossil elephants.

In another fossil tooth, I believe from Warwickshire, the characters of another species appear. The sides of the lines of enamel are smoother than in any of the other fossil teeth, and the digitated parts of the plates reach to the surface even in the anterior part of the tooth. But the most characteristic difference exists in the thickness and in the number of the plates of this species.

The thickness of the plates may be taken at nearly double that of the plates of fossil teeth in general; and their number must be proportionally fewer. In a fossil tooth from Essex, of the length of eight inches and a half, are twenty-two plates (*Pl.* X, *fig.* 8); whilst in this tooth, which is eight inches long, there are only thirteen plates, nine only of which are seen on the triturating surface, which is of the length of six inches (*Pl.* X, *fig.* 10). But it is not merely from the structure of the teeth that specific differences are inferred between the recent and the fossil elephants; Cuvier having ascertained some determinate differences between the skulls of the recent and the fossil species. He supposes that the fossil remains are of a species differing more widely from the Asiatic elephant (to which it approaches nearer than to the African), than the horse does from the ass.

No peculiarity of character is discoverable in the tusks of the fossil elephant.

Elephantine remains are generally found in the looser and more superficial parts of the earth, in various parts of the world. They have been found, as has been already mentioned, in some of the caverns containing animal remains, and frequently in thin grey-coloured beds on the surface of the London clay.

Rhinoceros.—There appear to be three existing species of rhinoceroses:—1. That of *India:* a unicorn with a rugous coat; with incisors, separated, by a space, from the grinders.—2. That of the *Cape:* a bicorn; the skin without rugæ, and no incisors.—3. That of *Sumatra:* a bicorn; the skin but slightly rugous, thus resembling that of the Cape; but having incisive teeth like that of India. In every adult rhinoceros there are twenty-eight grinders; seven on each side at the top and bottom. In the lower jaw are two large incisors, placed at the anterior angle; and between these are two very small incisive teeth, which remain concealed within the gums. There are also two large incisors in the upper jaw; and Cuvier has discovered, that there are also two very small incisors, which are disposed contrary to those of the lower jaw, on the outside of the large incisors.

The fossil remains of the rhinoceros have generally been found in similar situations to those in which the elephantine remains are met with; in Germany, at Darmstadt, Grubenhagen, on the banks of the Rhine, in the neighbourhood of Cologne, in Westphalia, and in various parts of France. The fossil remains of this animal have also been found in several parts of this island; in Warwickshire, Gloucestershire, Essex, and Middlesex.

We are indebted to Cuvier for ascertaining, by various comparisons of the fossil remains with the skeleton and with the living animal, that the animal whose fossil remains have been discovered differed materially from the rhinoceroses of the present day. The head of the fossil species is not only absolutely much larger than the living species, but it is much larger in proportion to the height of the limbs. The following circumstances, particularised by Cuvier, with others less striking, manifest that the differences between the recent and fossil animals must have been considerable. The occipital surface, which, in the recent skull, is nearly perpendicular, and, in the unicorn, even inclines forwards, extends backwards in all the fossil skulls. The meatus anditorius has its axis vertical in the living species, but is oblique in the fossil species. The fossil species has two horns, but the skull is not shaped like the bicorn of Africa: there is a considerable space between the bases of the two horns in the fossil species, whilst, in the rhinoceros of Africa and of Sumatra, the bases touch. The form of the bones of the nose, and their junction with the incisor bones, differ not only from the other rhinoceroses, but from all other known animals. The point of the nasal bones instead of terminating in a distinct projection, at a certain distance above the incisive, descends, without becoming thinner, before the nasal notches; and after being separated in three projecting tubercles, becomes united by a portion, which is a little thinner, to the incisive bones, where they form of themselves two other tubercles. All these four bones become so consolidated together, that the sutures by which they were connected, as well as that which distinguished the intermaxillary from the maxillary bones, are not perceptible at only a moderately advanced age. This structure, it is observed by Cuvier, so solid, was doubtlessly intended for the support of the horn, and gives us reason for supposing that it was more strong, and could be applied with more power in this species than in any of those which now exist.

As to the incisive teeth, Cuvier thinks, that the fossil animal had them not, at least, in the upper jaw; and, if in the lower jaw, they differed in size, and probably in form, from those of the living species.

The head of the rhinoceros brought to this country by Mr. Campbell, differing in the form and size of its horn from the common African rhinoceros, renders it desirable that it should be ascertained how far it agrees in character with the head of the fossil rhinoceros. The head of the fossil animal, as is shown above, differs from the bicorn of Africa, in having *a considerable space between the bases of the two horns;* and Mr. Campbell, with a due attention to correctness, states, "The common African rhinoceros has a crooked horn resembling a cock's spur, which rises about nine or ten inches above the nose, and inclines backward: immediately behind this is a short thick horn; but the head they brought had a straight horn projecting three feet from the forehead, and about ten inches from the tip of the nose. The projection of this great horn very much resembles that of the fanciful unicorn in the British arms. It has a small thick horny substance eight inches long, *immediately behind it*, which can hardly be observed on the animal at the distance of one hundred yards."

It appears, therefore, that the newly-discovered head of the African bicorn agrees with the common African bicorn, and differs from the fossil species in not having the space between the horns *.

Pallas found many of these fossil remains in Siberia, and, particularly, a complete rhinoceros, still covered by its skin, and buried in the sand on the borders of the river Wiluji. Hence Cuvier infers, that this unknown animal had not been brought from afar, nor had ceased to exist by any slow, but by some sudden, change of the earth. How could the animal found by Pallas, he asks, have come there from the Indies, or from any other warm country, without falling to pieces? How could it have been preserved, if the ice had not involved it suddenly; and therefore how could it have been involved in this manner, if the change of climate had been gradual and insensible?

Hippopotamus.—The existence of fossil remains of this animal was for some time disputed; but the fact was ascertained by Cuvier, by the examination of some fossil remains from Languedoc. Since that time similar remains have been found in various parts, and, particularly, in this island, in those situations in which the remains of elephants have also been discovered. They were found by Mr. Trimmer in the clay at Brentford, and I have obtained several interesting specimens during my researches on the Essex coast. But the most important discovery respecting this animal was made by

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* Travels in South Africa, undertaken at the request of the London Missionary Society, being a Narrative of a Second Journey in the Interior of that Country. By the Rev. John Campbell.

Cuvier, in the examination of some fossil remains, the locality of which could not be ascertained. By a careful investigation he was able to ascertain that they were the bones of an unknown species of hippopotamus. This animal, it appeared, could not have exceeded half the size of the existing species; it being evident, from the state of its teeth and the advanced progress of ossification, that its small size had not proceeded from its having been a young animal, but from a difference of species.

Tapir.—The only known species of this genus is an inhabitant of South America. It is formed like the hog, but is as tall as the ass, with its snout elongated into a moveable trunk. It has, in each jaw, six incisors and two canine teeth which are not longer than the incisors. Its skin is black, and almost without hair. It lives on the banks of rivers.

Two portions of the lower jaws which had been discovered in the black mountain, at Issel, in Languedoc, were found, by Cuvier, to agree generally with the tapir of South America. The differences were, that, in the tapir of South America, all the molares have their crown divided into two transverse risings, of an equal width; but, in the fossil animal, the three first molares, instead of transverse risings, have a kind of points or pyramids, the foremost of which is larger than that which is behind it. The anterior part of the muzzle is more narrow and long in the common tapir than in the fossil animal. In the tapir, also, the first molar is longer than any of the four or five following ones; but, in the fossil jaw, this is the shortest. M. Cuvier named this animal, *The small fossil tapir*.

A molar tooth was found in the neighbourhood of Vienna, and which appeared to have belonged to some large animal, supposed to resemble the tapir. Another specimen was found near St. Lary, in Couserans; and similar teeth are said to have been also found in Italy. But the most illustrative specimens were two halves of a jaw, with five molar teeth in each, found at Comminge, by the side of Breine.

The teeth of the recent tapir are divided by five transverse risings. Similar risings on the crown are observable in the teeth of the lamantin *(Trichecus manatus)*, and in those of the kangaroo. Such an agreement was discoverable, by Cuvier, in the teeth and in other circumstances between the tapir and the fossil animal, as induced him to consider these fossil remains as having belonged to a large animal, approximating to the known tapir, but which, he supposed, must have been one-fourth taller than the rhinoceros: this animal he calls, *The large fossil tapir*.

Mastodon.—The fossil remains of this enormous animal were first discovered in Albany in New England, rather more than one hundred years since; it being then described as a prodigious unknown animal, having the tusks of the elephant, with the grinders of the hippopotamus.

From a careful investigation of its remains, Cuvier thinks that we have a right to conclude that the mastodon did not exceed the elephant in height, but was rather longer in proportion; its limbs rather thicker, and its belly smaller. It appears to have had a trunk, and to have agreed with the elephant in having tusks, and in the whole of its osteology, excepting in its teeth, which differ so much in every respect from those of the elephant, as to forbid its being placed in the same genus.

The teeth are formed of an internal bony substance, with a thick cap of enamel. The crown is oblong, nearly rectangular, and divided by widely-spreading grooves intersected by another in a longitudinal direction, into two rows of large pyramidal points, over which the enamel is thickly disposed. The roots of the teeth are inserted into distinct and separate cavities in the mass of bone forming the jaws.

From the points and depressions of the teeth fitting into each other like the teeth of two saws, they must have been, Mr. Peale observes, incapable of lateral motion, and, consequently, of trituration; he therefore inferred, that it must have been a carnivorous animal: but, in the opinion of Cuvier, its food must have been similar to that of the hippopotamus and boar; preferring, perhaps, the roots and fleshy parts of vegetables.

According to Mr. Peale, there are but six vertebræ of the neck; nineteen dorsal vertebræ, and as many ribs were found, and one was supposed to be lost; three vertebræ remained, belonging to the loins.

The vertebræ agree, in general, with those of the elephant; but the ribs differ, in being thin towards the cartilage, and thick and strong towards the back. The scapula appears to possess the characters of the scapula of the elephant. The larger bones of the fore extremity are much thicker than those of the hind extremity. The enormous mass of the os femoris, and particularly its width, exceeds that of the existing as well as of the fossil elephant. The bones of the hind feet are remarkably smaller than those of the fore feet: it seems that the ungual phalanges had more motion than they have in the elephant, and approached nearer to those of the hippopotamus.

Other teeth of this animal have been found in several other parts of the world. In the neighbourhood of Dax and of Orleans; in Piedmont, in different parts of Lombardy; at Peru; the field of giants, near Santa Fé in

Terra Firma, and in the province of Chiquitos, in Paraguay.

From the investigations made by Cuvier, he considers that there are five species of this genus:—1. The *Mastodon* of the Ohio.—2. The *Mastodon* with narrow teeth, found at Simorre.—3. The small *Mastodon*, that with small teeth.—4. The *Mastodon* of the Cordilleras; the large animal with square teeth.—5. The *Mastodon* of De Humboldt, which is the smallest.

He was also able to determine, that, in an upper jaw of the second species, there had been three teeth; the foremost having four points, and one at the hinder part; the middlemost, six pair of points and two supplementary behind; and the hindmost, five pair of points, and one supplementary and undivided.

A tooth of the *mastodon* of the Cordilleras was found, by De Humboldt, at the height of twelve hundred toises, near to the volcano of Imbaburra, in the kingdom of Quito.

In the cliffs at Harwich are found fragments of bones; flat, seldom more than three inches wide and twelve inches long; their surfaces smoothed, as if by attrition; highly ferruginous, and yielding a sharp sound when struck upon. From the uniformly flat shape of the fragments, nothing can be inferred from them respecting the animal to which they belonged.

Within these few years, a tooth, with a similar ferruginous impregnation, was found on the beach at Harwich. This tooth had suffered much from bowldering, but still bore sufficient of its original form to give strong proof of its having belonged to this animal.

The success attendant on the labours of Cuvier whilst determining the generic characters of fossil bones; the distinguishing of the bones of the fossil elephant from those of the rhinoceros, or those of the bear from those of the hyæna, was not more than might have been expected. But to detect in fragments of fossil bones such differences as should determine with what recent species the fossil species agreed, and in what respects they differed from all known species, appeared to be a result beyond hope. His exertions and successes, however, did not stop here: from the discovery of a few detached bones in the plaster of Paris beds, he was led to suspect the existence of the remains of some animals of even different genera from any which were known in a living state: his researches were therefore continued with his usual perseverance, and terminated in the discovery of seven or eight different species of two entirely unknown genera.

He ascertained that the grinders of these animals were those of the herbivorous *pachydermata;* those of the upper jaw possessing a crown formed of two or three simple crescents; unlike those of the ruminants, in which the crescents are double, and have each four lines of enamel. These grinders he found, by a careful examination, were decidedly of different characters, and belonged to two different genera, one of which possessed canine teeth, the other not. To the former he gave the name *Palæotherium*, or ancient large animal or beast; and, to the other, *Anoplotherium*, or beast without weapons, thereby implying its distinguishing character, its want of canine teeth.

Palæotherium, or *large ancient animal.* — This animal, he ascertained, had seven grinders on each side of the lower jaw, the first being small, compressed, and rather sharp. Before the first small grinder, the jaw is void of teeth or sockets for a little space, and at the end of this space is the canine tooth. This tooth is not a tusk projecting out of the mouth, as in many species of hogs; it is rather concealed by the lips, as in the tapir, hippopotamus, and Mexican hog. The incisive teeth are of the common wedge-like form, and are six in number, as in the tapir. In the upper jaw are also six incisors, two canine teeth, and the grinders, having four roots, whilst those of the under jaw have only two. By the most ingenious investigations it was ascertained, that this animal possessed a kind of snout or trunk, resembling that of the tapir.

Correspondent bones were found of different sizes, by a careful and anxious comparison of which, the indefatigable enquirer ascertained that there existed in these quarries the remains of four species of this animal. One of which, of the size of a common cow or small horse, he named *Palæotherium magnum;* the next in size, nearly as large as a common hog, he named *P. medium*. From several other bones, remarkable for their thickness, he determined on the existence of another species, which he distinguished as *P. crassum;* and, from several fragments, he was enabled to determine that there also existed the remains of an animal of this genus, which could not be larger than a fox, to which he gave the name of *P. minus*.

By numerous accurate enquiries it was also ascertained that the feet of this animal were tridactyle; that the neck was longer than that of the tapir and hog, approaching those ruminants with a neck of a moderate size and with a slight form, such as the stags and the antelopes; and that the ribs were sixteen in number.

Imperfect remains of another animal were found, by Professor Herman, in the mountain of St. Sebastian, one of the lowest in the chain of Vosges. In this animal, as in the *Palæotherium*, were both incisors and canine teeth, but it had one molar tooth less, and no space between the first molar and the canine tooth. The other characters leave no doubt that this animal approached to the *Palæotherium*.

The *Anoplotherium* was traced from several grinding teeth having been found which appeared to belong to an animal which had no canine teeth: it indeed appeared, that in the lower jaw of this animal there had been fourteen grinding and six incisive teeth, without any canine tooth or intervening space. The teeth of the upper jaw appear to correspond with those of the lower jaw; there not being any canine tooth, or any space between the incisors and the grinders.

Besides other particularities of structure, it was found that, in this animal, the hind leg had two perfect toes articulated with two metatarsal bones, which remained distinct and separate through life: a structure unknown among living animals.

The most common species of this animal, *An. commune*, appears to have rather exceeded, in its size, the wild boar. The foot of *A. medium* was of a size which would have agreed with that of a sheep of a middling size. *A. minus*, reckoning from the size of its foot, was about the size of the hare.

After the examinations of various specimens of separate bones, during eight years, two skeletons were fortunately obtained which were nearly complete. The first was of an animal of nearly the size of a small horse. The ribs were found to be twelve, and the tail was ascertained to be of vast magnitude, being formed of, at least, twenty-two vertebræ; and equalling, if not surpassing, the body in length: there were reasons also for supposing that the thickness of the tail must have been as enormous as its length.

Half the jaw of a small carnivorous animal of the genus *Canis*, of an unknown species, was also found in these quarries, and the astragalus of some carnivorous animal, one third smaller. Remains of tortoises and *lacertæ* were also found here; but, of the latter, only one or two specimens.

Agreeable to the important remarks of Cuvier, we find that, in the country in which these quarries exist, so extensive as to reach twenty leagues from east to west, hardly any bones have been found but of one family, the *Pachydermata.* He is hence led to remark, that the present state of large islands, as New Holland in particular, may teach us what may have been that of the country which was inhabited by the fossil animals of these quarries. In these quarries one carnivorous animal only has been found, and eight species of *Pachydermata.* In New Holland five-sixths of the quadrupeds also belong to one family, *Pedimanes,* or marsupial quadrupeds; whilst the countries forming the two great continents are inhabited by all the families of quadrupeds, according to climate, nature of soil, &c.

In the loose soil of vallies and large plains, he observes, are found the bones of eleven species, differing from the known species of the order *Pachydermata:* a rhinoceros, two hippopotamuses, two tapirs, an elephant, and five mastodons, the latter being of a genus distinct and unknown, and the former, though belonging to known genera, differing from all known species. These bones he considers as having been enveloped by the last, or one of the last, catastrophes of this globe; and being frequently covered with remains of marine animals, but not with regular beds of conchiferous stone, he concludes this catastrophe to have been a great but transient inundation of the sea. Before this catastrophe these animals lived, he therefore supposes, in the climates in which we now dig up their bones.

Tardigradi.—The *Megatherium* of Paraguay, and the *Megalonyx* of Virginia, are among the last animals of a former world, for a just knowledge of the nature of which we are indebted to our illustrious teacher, Cuvier, who has ascertained that they are two species of the same genus belonging to the family of *Edentata*, and may be placed between the sloths and the ant-eaters, but nearer to the former than to the latter. The wonderful anatomy of the sloths, displaying such deviations from that beautiful adaptation of parts to the offices which they are to perform, and producing the personification, as it were, of wretchedness, manifests such peculiarities of structure as can hardly fail to be recognised in any tolerably preserved remains. The arm and fore arm together are nearly twice as long as the leg and thigh, so that, when the animal would walk on all four, it is obliged to trail along on its elbows: the pelvis is so wide, and the cotyloid cavities turned so backwards, that it is obliged to keep the thighs wide asunder. The construction of the articulation of the hind feet appears as if it was intended to prevent the animal from having any power of using them. Instead of the articulation with the astragalus, allowing the foot to bend on the leg, the fibula is inserted, like a pivot, in a conical pit on the top of the astragalus, the foot turning round like a vane on its staff; and the foot is so placed that the sole cannot be put to the ground but by stretching out the leg in almost a horizontal direction.

The toes of the animal are inclosed quite to the nails in a stiff skin, which will allow only of their being bent and straightened altogether; and to add to its difficulty of motion, several bones, which in other animals are always distinct, are here joined together. The nails, which are of an enormous length, are bent, when the animal does not use them, under the foot, with their convex side towards the ground.

In the western part of Virginia is a limestone, abounding with large caverns, in digging the floor of one of which, a fragment of a femur, the two condyles being nearly entire, a radius, an ulna, three claws, and half a dozen other bones of the feet, were discovered; one of the claws being seven inches and a half long. To the animal to which these bones belonged the name was given of *Megalonyx*, from the size of its claws.

Cuvier, on examining the casts of these bones, was enabled to determine that they were the remains of an animal of a species of sloth *(Bradypus)* hitherto unknown. The bones of the fore arm are about a sixth longer than those of a common ox; and on the supposition that the other parts were in the same proportion, the animal must have equalled, in size, the largest oxen of Switzerland or Hungary.

About the same time that the above remains of the *Megalonyx* were found in North America, several extraordinary and unknown bones were found in the banks of the river Luxan, about three leagues west of Buenos Ayres. Bones of a similar animal were also found at Lima and at Paraguay. The bones found at Luxan were sent to Madrid, and, being carefully connected, formed a skeleton, which is preserved in the Royal Museum.

From a general view of the skeleton some well-founded conjectures may be formed of the animal itself. Cuvier instructs us, that his teeth prove he lived on vegetables; and his fore feet, robust, and armed with sharp claws, point out that roots were the chief objects of his search. His claws supplied him with arms sufficient for his defence. His progress was not swift, nor was it requisite that it should be, since he was not under the necessity of flying or of pursuing. Cuvier adds, if he still exists, where can he be? or can he have escaped from all the researches of naturalists and huntsmen? The bones of the *Megatherium* are one third larger than those of the *Megalonyx*.

Gnawers.—In different peat mosses, and in other situations in which their remains might be expected to be found, the remains of *Beavers* have been discovered, though not very frequently. Their teeth are known by the enamel of the crown, in those of the upper jaw, being so disposed as to form a line with three turns inwards, on the outer border, and on the inner side a single one; and by the arrangement of the enamel, in the teeth of the under jaw, being exactly reversed. But in none of the heads, which have been thus found, have any characters been observed different from those of the existing animals.

In the beds of calcareous and marly schists of Oeningen, &c. was found the remains of one of this class of animals, which Cuvier believes to be a species of *Cavia*. Another was also found, in a similar situation, at Walsch in Bohemia, resembling *Mus terrestris*.

Fossil Bones in Caverns.—The phenomena which are here offered to our observation differ essentially from those which we have just viewed. Here the bones are almost all of carnivorous animals, either lying loosely at the bottom of caverns covered with animal earth, or encased in stalagmitic concretions. Many of these caverns have been mentioned by different authors, as existing in several parts of Germany. Leibnitz describes Bauman's Cave, near Blankenbourg; Einhornshoele in Scharzfeld is described by M. de Luc; and several, in the chain of the Hartz, are particularised by Behrens, in his *Hercynia Curiosa*. They exist, indeed, in many parts of Germany.

The most remarkable are the caverns of Gaylenreuth near Bayreuth. The opening to these is at the foot of a rock of limestone (oolite?), passing into a grotto about three hundred feet in circumference, which is divided by the form of the roof into four caves. Fragments of bones are still found in these caves, and, it is said, were once as numerous as in the interior of the grottees. The second grotto was found to be sixty feet long, about forty feet wide, and beautifully set with stalactites; the floor being so covered with a sparry crust, as to prevent any search there for bones. On passing through a hole three feet high, an entrance was gained into the third grotto, about thirty feet across and nearly round, the sides being fantastically adorned by its stalactitical hangings, and its floor covered with a wet and slippery glazing, through which several bones, jaws, and teeth projected. Hence a descent of about twenty feet led to the inferior caverns, where M. Esper, the narrator, expected to be left to augment the number of zoolites contained in these terrific mansions. The rock itself was here thickly beset with teeth and bones, and the floor covered with a loose earth, the result of animal decomposition, which also contained numerous bones. A gradual descent led to another grotto, which, with its passage, was forty feet in length. Twenty feet further was a terrible gulph, at the bottom of which was another grotto about the same size as the last, and also covered with animal earth and numerous bones. Several intricate passages and five other caves terminated in a grotto above forty feet long and wide. Here the prodigious quantity of animal earth, the vast number of teeth, jaws, and other bones, and the heavy grouping of the stalactites, produced so dismal an appearance, as to lead Esper to speak of it as "a model for a temple for a god of the dead*."

The bones which have been discovered in similar caverns, over an extent of more than two hundred leagues, are almost all found in the same state, and under the same circumstances, and appear to belong to similar animals. Rosenmuller and Camper were satisfied that these bones were chiefly of the bear: and Blumenbach was able to distinguish two species; one, with a raised forehead, only known in these situations, which he named *Ursus spelæus;* and another, which he considered, with Camper, as the white or polar bear, *Ursus arctoideus.* Cuvier also examined these remains, and was of opinion that they were those of two species hitherto unknown among the living species.

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* Description des Zoolites nouvellement decouvertes d'Animaux, Quadrupedes, inconnue, et des Cavernes qui les renferment, par J. E. Esper, 1774.

The following is an abridged account, from The Annals of Philosophy, March 1822, of Professor Buckland's interesting paper, read before the Royal Society, on an English cavern, resembling, in its contents, those which have been just mentioned:—

This paper gives a detailed account of a den of hyænas discovered in the summer of 1821, at Kirkdale, near Kirby Moorside, in Yorkshire, about twenty-five miles north-east of York.

"The den is a natural fissure, or cavern, in oolitic limestone, extending three hundred feet into the body of the solid rock, and varying from two to five feet in height and breadth. Its mouth was closed with rubbish, and overgrown with grass and bushes, and was accidentally intersected by the working of a stone quarry. It is on the slope of a hill, about one hundred feet above the level of a small river, which, during great part of the year, is engulphed. The bottom of the cavern is nearly horizontal, and is entirely covered, to the depth of about a foot, with a sediment of mud deposited by the diluvian waters. The surface of this mud was, in some parts, entirely covered with a crust of stalagmite; but on the greater part of it there was no stalagmite. At the bottom of this mud, the floor of the cave was covered from one end to the other with teeth and fragments of bone of the following animals:—hyæna, elephant, rhinoceros, hippopotamus, horse, ox, two or three species of deer, bear, fox, water-rat, and birds.

"The bones are for the most part broken, and gnawed to pieces, and the teeth lie loose among the fragments of the bones; a very few teeth remain still fixed in broken fragments of the jaws. The hyæna bones are broken to pieces as much as those of the other animals. No bone or tooth has been rolled, or in the least acted upon by water, nor are there any pebbles mixed with them. The bones are not at all mineralised, and retain nearly the whole of their animal gelatin, and owe their high state of preservation to the mud in which they have been imbedded. The teeth of hyænas are most abundant; and of these, the greater part are worn down almost to the stumps, as if by the operation of gnawing bones. Some of the bones have marks of the teeth on them; and portions of the fœcal matter of the hyænas are found also in the den. These have been analised by Dr. Wollaston, and found to be composed of the same ingredients as the *album græcum*, or white fæces of dogs that are fed on bones, viz. carbonate of lime, phosphate of lime, and triple phosphate of ammonia and magnesia; and, on being shown to the keeper of the beasts at Exeter Change, was immediately recognised by him as the dung of the hyæna. The new and curious fact of the preservation of this substance is explained by its affinity to bone.

"The animals found in the cave agree in species with those that occur in the diluvian gravel of England, and of great part of the northern hemisphere: four of them, the hyæna, elephant, rhinoceros, and hippopotamus, belong to species that are now extinct, and to genera that live exclusively in warm climates, and which are found associated together only in the southern portions of Africa, near the Cape. It is certain, from the evidence afforded by the interior of the den (which is of the same kind with that afforded by the ruins of Herculaneum and Pompeii), that all these animals lived and died in Yorkshire, in the period immediately preceding the deluge; and a similar conclusion may be drawn with respect to England generally, and to those other extensive regions of the northern hemisphere, where the diluvian gravel contains the remains of similar species of animals. The extinct fossil hyæna most nearly resembles that species which now inhabits the Cape, whose teeth are adapted beyond those of any other animal to the purpose of cracking bones, and whose habit is to carry home parts of its prey to devour them in the caves of rocks which it inhabits. This analogy explains the accumulation of the bones in the den at Kirkdale. They were carried in for food by the hyænas; the smaller animals, perhaps, entire; the larger ones piecemeal; for by no other means could the bones of such large animals as the elephant and rhinoceros have arrived at the inmost recesses of so small a hole, unless rolled thither by water; in which case, the angles would have been worn off by attrition, but they are not.

"Judging from the proportions of the remains now found in the den, the ordinary food of the hyænas seems to have been oxen, deers, and water-rats; the bones of the larger animals are more rare; and the fact of the bones of the hyænas being broken up equally with the rest, added to the known preference they have for putrid flesh and bones, renders it probable that they devoured the dead carcases of their own species. Some of the bones and teeth appear to have undergone various stages of decay by lying at the bottom of the den while it was inhabited, but little or none since the introduction of the diluvian sediment in which they have been imbedded. The circumstances of the cave and its contents are altogether inconsistent with the hypothesis of all the various animals of such dissimilar habits having entered it spontaneously, or having fallen in, or been drifted in by water, or with any other than that of their having been dragged in, either entire or piecemeal, by the beasts of prey whose den it was.

"Five examples are adduced of bones of the same animals discovered in similar caverns in other parts of this country, viz. at Crawley Rocks near Swansea, in the Mendip Hills at Clifton, at Wirksworth in Derbyshire, and at Oreston near Plymouth. In some of these, there is evidence of the bones having been introduced by beasts of prey; but in that of Hutton Hill, in the Mendips, which contains rolled pebbles, it is probable they were washed in. In the case of open fissures, some may have fallen in.

"A comparison is then instituted between these caverns in England, and those of Germany described by Rosenmuller, Esper, and Leibnitz, as extending over a tract of two hundred leagues, and containing analogous deposits of the bones of two extinct species of bear, and the same extinct species of hyæna that occurs at Kirkdale.

"In the German caves, the bones are in nearly the same state of preservation as in the English, and are not in entire skeletons, but dispersed as in a charnel house. They are scattered all over the caves, sometimes loose, sometimes adhering together by stalagmite, and forming beds of many feet in thickness. They are of all parts of the body, and of animals of all ages; but are never rolled. With them is found a quantity of black earth derived from the decay of animal flesh; and also, in the newly-discovered caverns, we find descriptions of a bed of mud. The latter is probably the same diluvian sediment which we find at Kirkdale. The unbroken condition of the bones, and presence of black animal earth, are consistent with the habit of bears, as being rather addicted to vegetable than animal food, and, in this case, not devouring the dead individuals of their own species. In the hyæna's cave, on the other hand, where both flesh and bones were devoured, we find no black earth; but, instead of it, we discover in the *album græcum* evidence of the fate that has attended the carcases and lost portions of the bones whose fragments still remain.

"Three-fourths of the total number of bones in the German caves belong to two extinct species of bear, and two-thirds of the remainder to the extinct hyæna of Kirkdale. There are also bones of an animal of the cat kind (resembling the jaguar, or spotted panther of South America), and of the wolf, fox, and polecat, and rarely of elephant and rhinoceros *.

"The bears and hyæna of all these caverns, as well as the elephant, rhinoceros, and hippopotamus, belong to the same extinct species that occur also fossil in the diluvian gravel; whence it follows that the period in which they inhabited these regions was that immediately preceding the formation of this gravel by that transient and universal inundation which has left traces of its ravages committed at no very distant period over the surface of the whole globe, and since which no important or general physical changes appear to have affected it.

"Both in the case of the English and German caverns, the bones under consideration are never included in the solid rock; they occur in cavities of limestone rocks of various ages and formations, but have no further connexion with the rocks themselves, than that arising from the accident of their being lodged in cavities produced in them by causes wholly unconnected with the animals, that appear for a certain time to have taken possession of them as their habitation[*]."

---

* "M. Rosenmuller shows that the bears not only lived and died, but were also born, in the same caverns in which their bones have been thus accumulated; and the same conclusion follows from the facts observed in the cave in Yorkshire."

* * *

We cannot quit these monuments of former worlds without alluding to the incontrovertible evidence they present of the exercise of Almighty Power and of the perpetual influence of a Divine Providence.

In the several formations composing the outer part of the earth down to the primitive rocks, vast accumulations exist of the fossil remains of organised beings, varying in each formation, and essentially differing from those beings which now exist. The discovery of animals peculiar to certain formations, and the general agreement with each other of the fossils of the same formations, have led to the belief that these several formations were the consequences of successive changes effected on the earth's surface; and that their contained fossils are the preserved remains of the several creations which had been successively formed to accord with the state of the planet under its several changes.

In the lower and consequently earlier formed strata, the beds associated with coal, are found the bituminised remains of unknown vegetables: and in the masses of mountain limestone, &c., are immense accumulations of crinoideal and terebratular remains, of the numerous species of which tribes scarcely a living individual can now be found. In these situations also exist the mineralised remains of multilocular univalve and bivalve shells, and of others of more simple forms, possessing such a structure as enabled the animals which inhabited them to rise or sink in the water as circumstances required. Many genera of this tribe are here found in their mineralised state, as *Ammonites*, *Belemnites*, *Orthoceratites*, &c., some of which, as the *Ammonites*, are spread through the succeeding superior formations, in myriads; but no living individual of these genera is known. The genus *Nautilus* is the only one whose existence, through a few species, is continued to the present day.

---

[*] The hyæna's habit of digging human bodies from the grave, and dragging them to their den, and accumulating around it the bones of all kinds of animals, is thus described by Busbequius, in speaking of the Turkish custom of laying great stones on their graves to guard them from the hyænas:—

"Hyæna regionibus iis satis frequens sepulchra suffodit, extrahitque cadavera portatque ad suam speluncam juxta quam videri est ingentem cumulum ossium humanorum veterinariorum et reliquorum omne genus animalium."—*Leg. Turc.* Epist. 1.

The fossils of the succeeding superior formation, the lias, yield strong proofs of their having been the production of a distinct creation. Among them is found the first trochiform univalve, *Trochus Anglicanus*; with numerous genera of bivalves, differing essentially and generically from those contained in the preceding formation; such are the different species of *Ostrea*, *Gryphæa*, *Trigonia*, and several others.

But the most decided proofs of these fossils being the remains of another world, and of a distinct creation, is their containing the relics of a tribe of enormous marine animals: quadrupeds, possessing the blended structure of fish and lizard; the *Ichthyosaurus*, *Plesiosaurus*, &c., no traces of which have been discovered in any of the preceding strata.

The fossil remains through the succeeding higher formations of oolite, green sand, chalk, and clay, show new genera both of saurian and testaceous animals; among the former are crocodiles, monitors, &c.; and among the latter are numerous turbinated and turretted kinds. But when we follow, on the surface of the vast mass of upper clay, the traces of diluvial torrents and the desolation which accompanied the last grand catastrophe which the planet appears to have sustained, we there find the remains of another creation, the terrestrial quadrupeds; a new order of animals, differing in almost every respect from those which had preceded them, and of which not a single bone is to be found in any of the preceding formations.

It appears that the devastating effects accompanying the vast change which this planet then underwent were so extensive, that not only some species of quadrupeds were entirely removed, of some genera, such as the elephant, rhinoceros, and hippopotamus, of which other species still remain; but that other genera, as *Mastodon*, *Palæotherium*, and *Anoplotherium*, were completely annihilated through all their species.

These changes in the state of the planet, and this partial destruction of quadrupeds, appears to have been succeeded by the creation of man, and of such quadrupeds and other animals as were fit inhabitants of the earth after its last change. But man did not retain his dominion uninterrupted long. The Scriptures teach us, that a flood of waters was brought upon the earth, which prevailed on it for an hundred and fifty days, and by which the whole race was nearly destroyed. The Mosaic account of this deluge has, however, been doubted, from the total absence of the fossil remains of man. But reference will show that no circumstances are stated in that account which will authorise the supposition, that the deluge was accompanied by such subversive violence as would bury its victims in those situations which would dispose to the mineralisation of their remains.

The assumption of successive creations with accordant changes in the state of the planet, does not, indeed, agree with the Mosaic account of the creation; at least, in its ordinary acceptation. The facts, however, appear to be as they are stated. May not the discordance depend on a misconception of the Sacred Writings? Once more, with submission and deference—may not the days of creation be considered as periods of long and indefinite duration?

This system of successive creations fitted to the existing or predestined state of the planet, appears, not only not to derogate from the wisdom and power of the Almighty, but to be perfectly in agreement with the agency of Providence as taught by the Divine Author of our religion. The world is seen, in its formation and continuance, constantly under the providence of Almighty God, without whose knowledge not one sparrow falls to the ground.

Under these impressions, we view the results of these several changes and creations as manifesting the prescience, the power, and the benevolence of our great Creator. The general form of the earth's surface, varied by the distribution of hills and vallies, and of land and water; the prodigious accumulations of coal derived from the vegetables of a former creation, with the accompanying slates and schists; the useful, durable, and often beautiful, encrinital and shelly limestones; the immense formations of chalk and flint, and the various series of clays; all demonstrate a careful provision for the wants of man. The several breaks and faults in the stratified masses, and the various inclinations of the strata, as well as the vast abruptions by which these several substances are brought to the hand of man, may be regarded as most beneficent provisions resulting from catastrophes too vast and tremendous for human intellect to comprehend.

From these several creations it appears that beings have proceeded, gradually increasing in superiority, from testaceous animals to reptiles, marine and fresh water amphibia, quadrupeds, and lastly to man, who, in his turn, is destined, with the earth he inhabits, to pass away, and be succeeded by a new heaven and a new earth.

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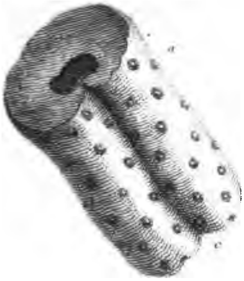

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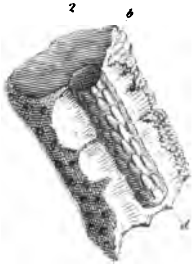

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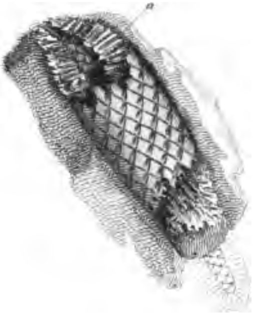

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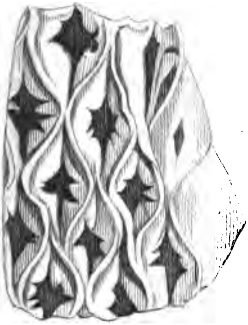

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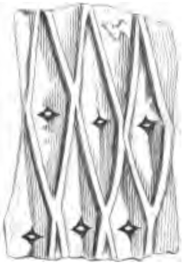

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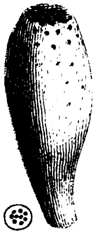

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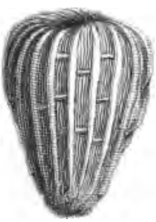

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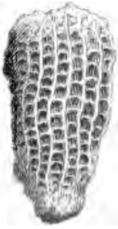

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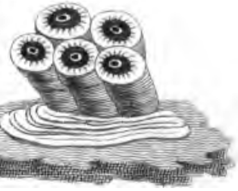

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Published for the Author July 1.1822.

Pl.II.

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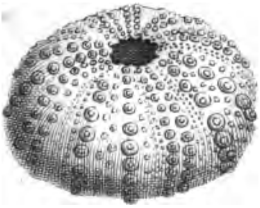

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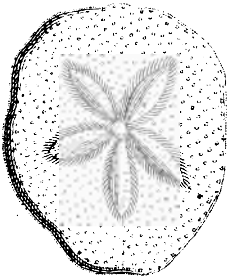

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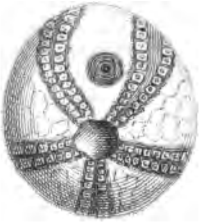

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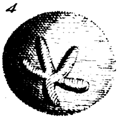

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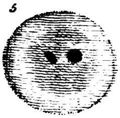

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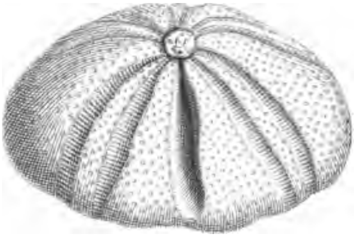

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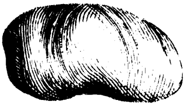

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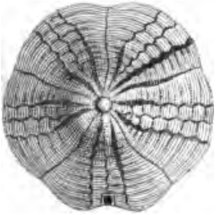

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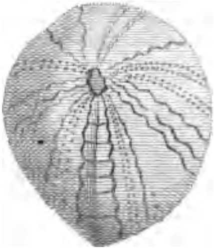

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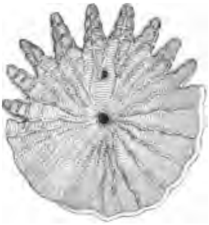

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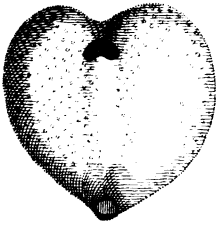

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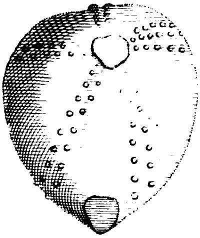

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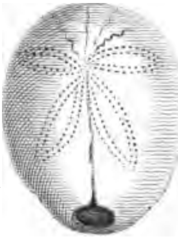

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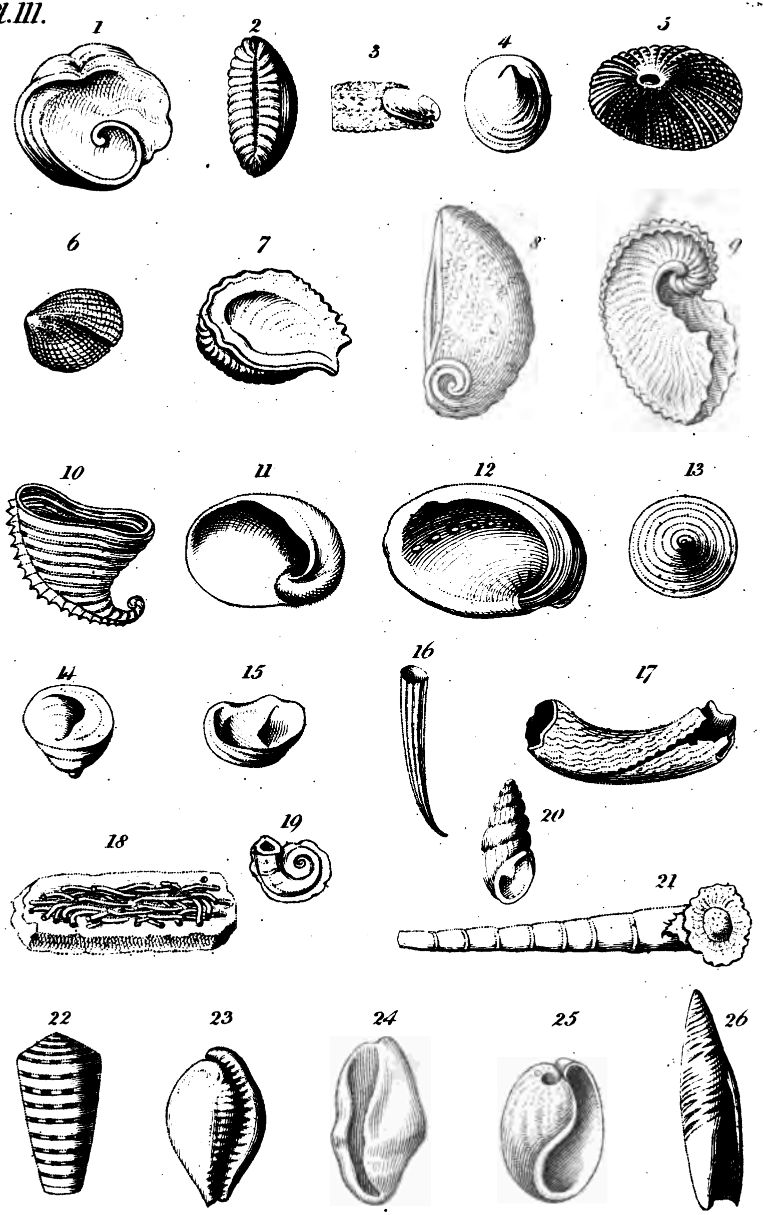
Pl. III.



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Pl.IV.

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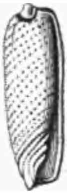

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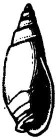

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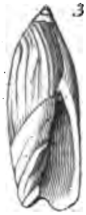

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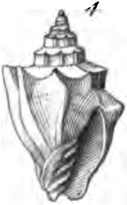

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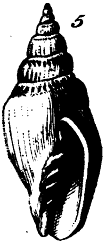

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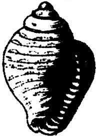

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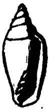

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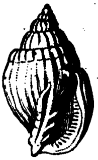

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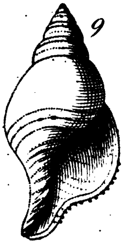

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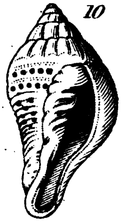

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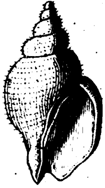

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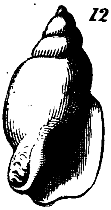

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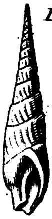

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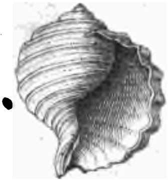

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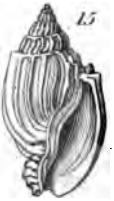

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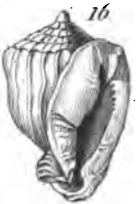

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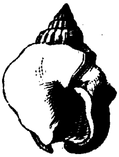

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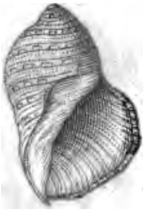

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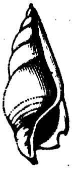

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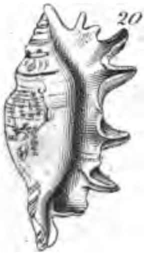

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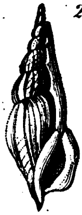

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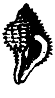

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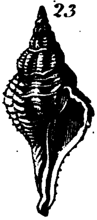

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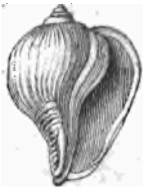

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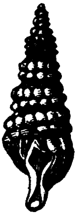

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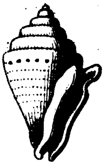

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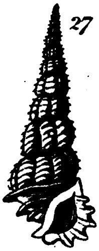

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Pl.V.

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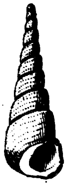

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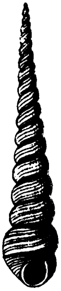

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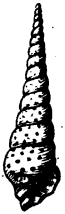

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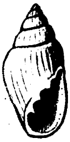

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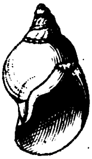

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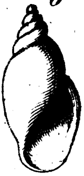

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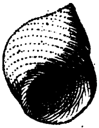

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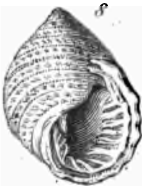

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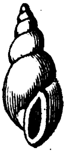

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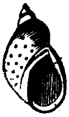

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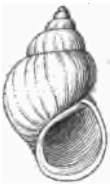

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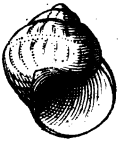

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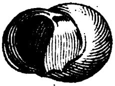

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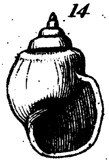

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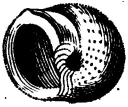

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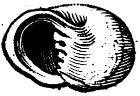

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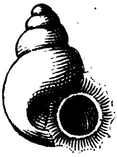

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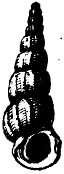

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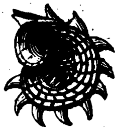

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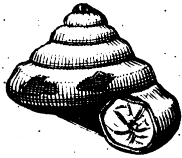

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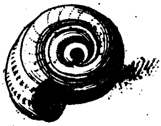

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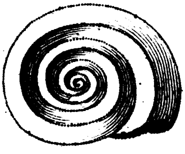

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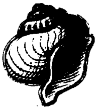

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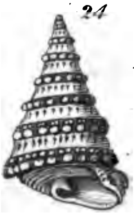

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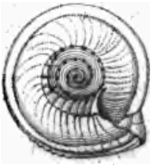

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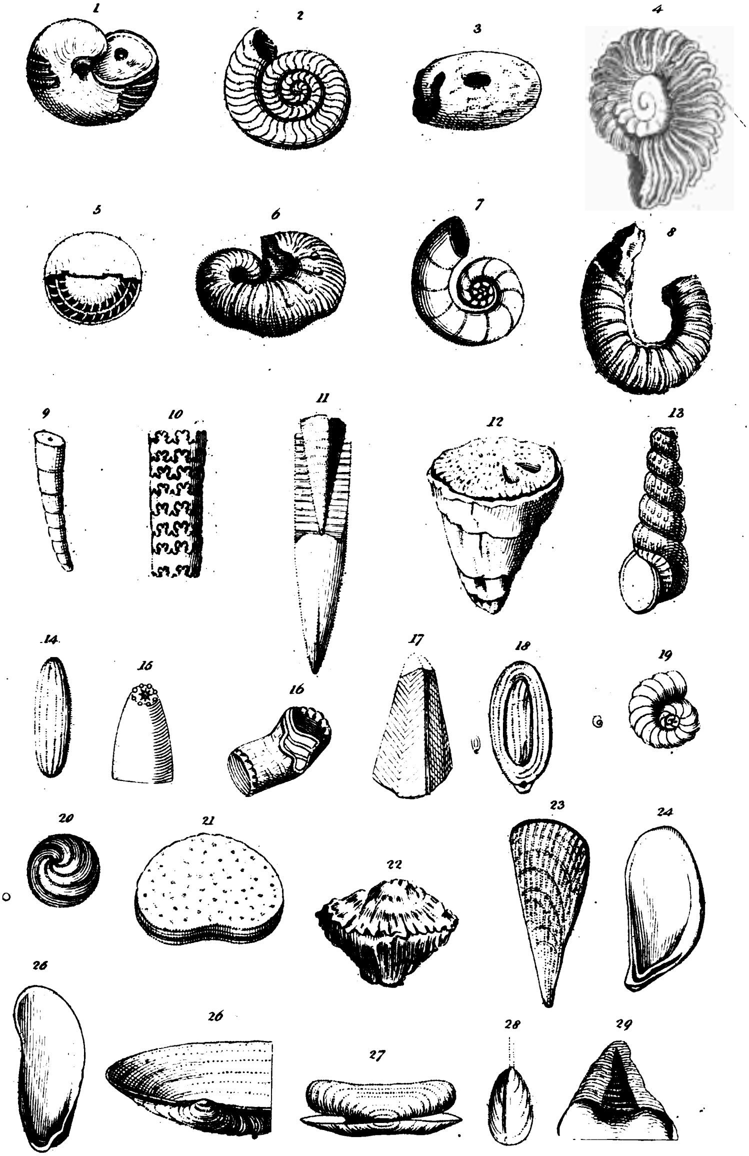
Pl. VI.



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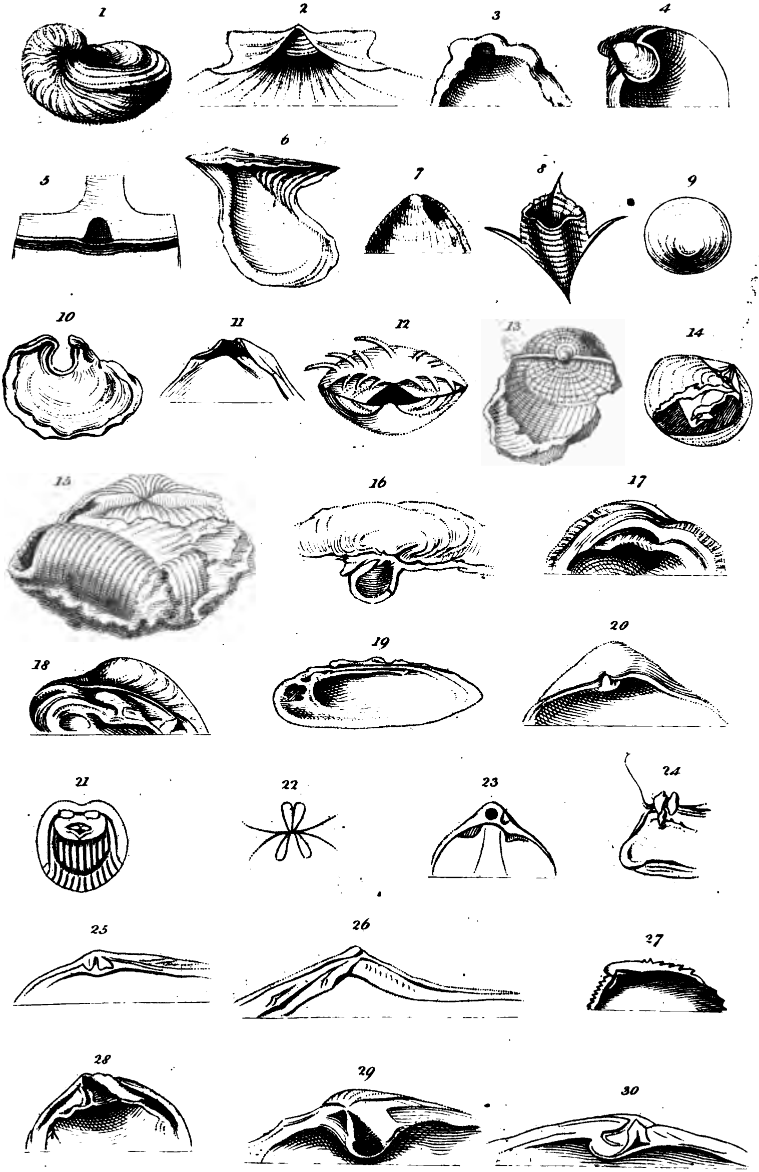
Pl. VII.



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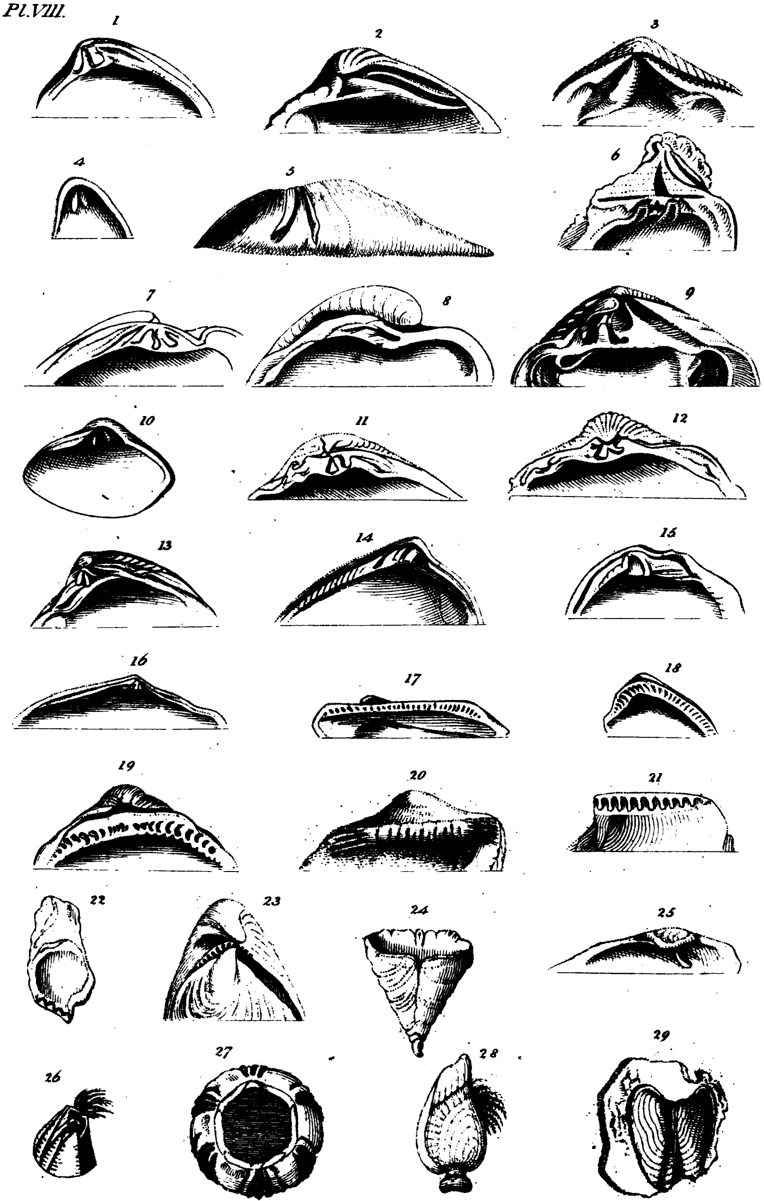
Pl. VIII.



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Pl.IX.

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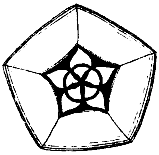

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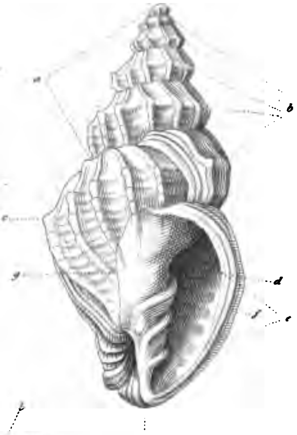

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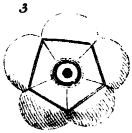

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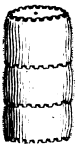

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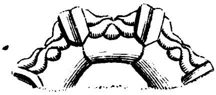

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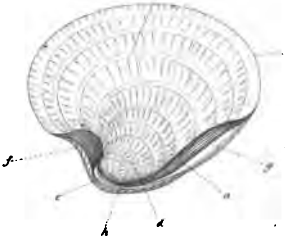

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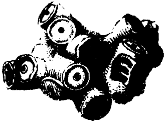

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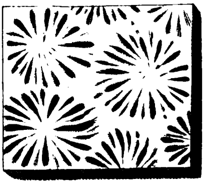

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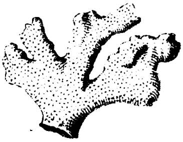

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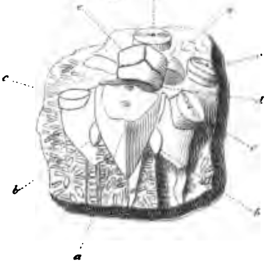

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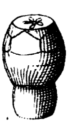

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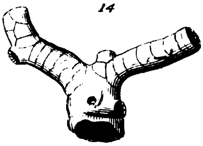

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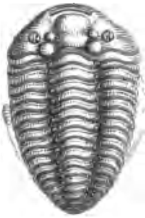
Pl. X.

1



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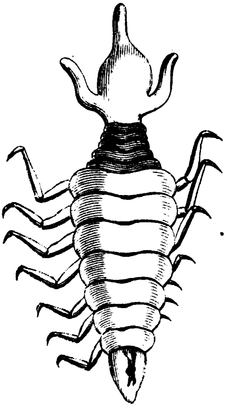

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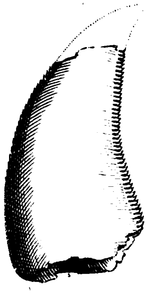

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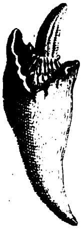

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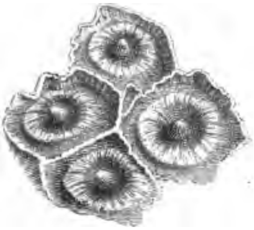

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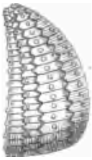

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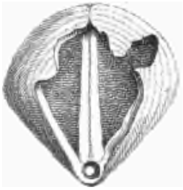

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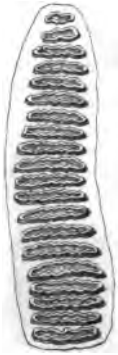

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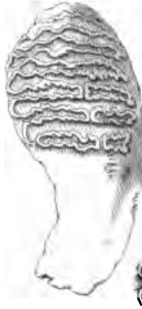

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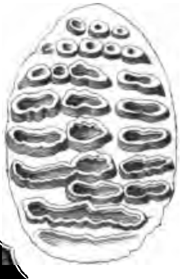

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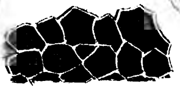

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EXPLANATION *of the* PLATES.

Plate I.

Fig.

1. Phytolithus verrucosus.
    - *a.* suppressed tubercles.
    - *c.* longitudinal sulcus.
2. Phytolithus verrucosus.
    - *b.* traces of leaves.
    - *d.* included, cylindrical body.
3. Fossil strobilus.
    - *a.* tubular processes passing from the internal part to the surface.
4. Phytolithus cancellatus, epidermal surface.

Fig.

5. Phytolithus cancellatus, cortical surface.
6. Phytolithus cancellatus, ligneous surface.
7. Transverse section of Siphonia.
8. Upper extremity of Siphonia Websteri.

9.
10. } Species of Mantellia.

11.
12. } Fossil teeth from Stonesfield slate.
13.

14. Palythoa.

Plate II.

Fig.

1, represents the general form and characters of the genus Echinus and Cidaris; the tubercles being perforated in the latter genus.

2. Clypeaster.
3. Galerites.

4.
5. } Fibularia.

Fig.

6. Clypeus.
7. Cassidulus.
8. Echinarachnius.
9. Ananchytes, the upper surface.
10. Scutella.
11. Spatangus (Cor. Marinum).
12. Ananchytes, the under surface.
13. Spatangus (Ovum Marinum, Brissus).

Plate III.

Fig.

1. Planospirites.
2. Oscana.
3. Testacella.
4. Patella.
5. Fissurella.
6. Emarginula.
7. Concholepas.
8. Stomatia.
9. Argonauta.

Fig.

10. Carinaria.
11. Sigaretus.
12. Haliotis.
13. Calyptrea.
14. Infundibulum.
15. Crepidula.
16. Dentalium.
17. Siliquaria.
18. Vermicularia

Fig.

19. Serpula.
20. Pupa.
21. Aspergillum.
22. Conus.
23. Cypræa.
24. Ovula.
25. Bulla.
26. Terebellum.

EXPLANATION OF THE PLATES.

Plate IV.

Fig.
1. Volvaria.
2. Oliva.
3. Ancilla.
4. Voluta.
5. Mitra.
6. Columbella.
7. Marginella.
8. Cancellariæ.
9. Fasciolaria.

Fig.
10. Turbinellus.
11. Buccinum.
12. Eburna.
13. Terebra.
14. Dolium.
15. Harpa.
16. Cassis.
17. Nassa.
18. Pupura.

Fig.
19. Strombus.
20. Pterocera.
21. Rostellaria.
22. Murex.
23. Fusus.
24. Pyrula.
25. Pleurotoma.
26. Clavatula.
27. Cerithium.

Plate V.

Fig.
1. Melania.
2. Turritella.
3. Pyramidella.
4. Auricula.
5. Achatina.
6. Lymnæa.
7. Turbo.
8. Monodonta.
9. Bulimus.

Fig.
10. Phasianella.
11. Vivipara.
12. Helix.
13. Helicina.
14. Ampullaria.
15. Natica.
16. Nerita.
17. Cyclostoma.

Fig.
18. Scalaria.
19. Delphinula.
20. Cirrus.
21. Planorbis.
22. Euomphalus.
23. Ianthina.
24. Trochus.
25. Solarium.

Plate VI.

Fig.
1. Nautilus.
2. Ammonites.
3. Nautellipsites.
4. Ammonellipsites.
5. Nummulites.
6. Scaphites.
7. Lituites.
8. Hamites.
9. Orthoceratites.
10. Baculites.

Fig.
11. Belemnites.
12. Hippurites.
13. Turrilites.
14. Fasciolites.
15. Acamas.
16. Amplexus.
17. Conularia.
18. Miliolites.
19. Cornu Ammonis Ariminiense.

Fig.
20. Gyrogonites.
21. Acardo.
22. Radiolites.
23. Pinna.
24. Mytilus.
25. Modiola.
26. Anodonta.
27. Glycimeris.
28. Lingula.
29. Ostrea.

Plate VII.

Fig.
1. Gryphæa.
2. Pecten.
3. Lima.
4. Vulsella.
5. Malleus.
6. Avicula.
7. Pedum.
8. Hyalæa.
9. Orbicula.
10. Anomia.

Fig.
11. Dianchora.
12. Plagiostoma.
13. Productus.
14. Magas.
15. Spirifer.
16. Mya.
17. Chama.
18. Hippopodium.
19. Unio.
20. Corbula.

Fig.
21. Crania.
22. Petricola.
23. Terebratula.
24. Solen.
25. Sanguinolaria.
26. Tridacna.
27. Cardita.
28. Paphia.
29. Lutraria.
30. Mactra.

EXPLANATION OF THE PLATES.

Plate VIII.

Fig.
1. Astarte.
2. Venericardia.
3. Trigonia.
4. Plicatula.
5. Placuna.
6. Spondylus.
7. Venus.
8. Isocardia.
9. Crassatella.
10. Erycina.

Fig.
11. Donax.
12. Cardium.
13. Cytherea.
14. Cyrena.
15. Lucina.
16. Tellina.
17. Arca.
18. Nucula.
19. Pectunculus.
20. Cucullæa.

Fig.
21. Perna.
22. Crenatula.
23. Inoceramus.
24. Calceola.
25. Pholas.
26. Balanus.
27. Coronula.
28. Anatifa.
29. Trigonellites.

Plate IX.

Fig.
1. The base of the Lily Encrinus, or Encrinites Moniliformis.
2. Univalve shell.
3. The base of the Cap Encrinite of Derbyshire, Lancashire, &c.
4. Trochite, or encrinital vertebra.
5. The straight Encrinite.
6. Entrochite, or part of an encrinital spine.
7. The base of the turban Encrinite.

Fig.
8. Bivalve Shell.
9. Internal part of the valve of a species of Productus.
10. Tubipora Anastomosans, p. 71.
11. Astræa in Calcedony.
12. Frondescent Millepore.
13. Bottle Encrinite.
14. Stagshorn Encrinite.
15. Clove Encrinite.
16. Head of a Pentacrinite.

Plate X.

Fig.
1. Dudley Fossil, or Trilobite.
2. Oniscus Prægustator.
3. Part of a Jaw from the Stonesfield slate.
4. Stylina, simple.
5. Stylina, compound.
6. Portion of an Echinus.
7. Pentamerus.

Fig.
8. Ordinary Fossil Tooth of the Elephant.
9. Fossil Tooth of the Elephant, the plates winding.
10. Fossil Tooth of the Elephant, the plates of extraordinary thickness.

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